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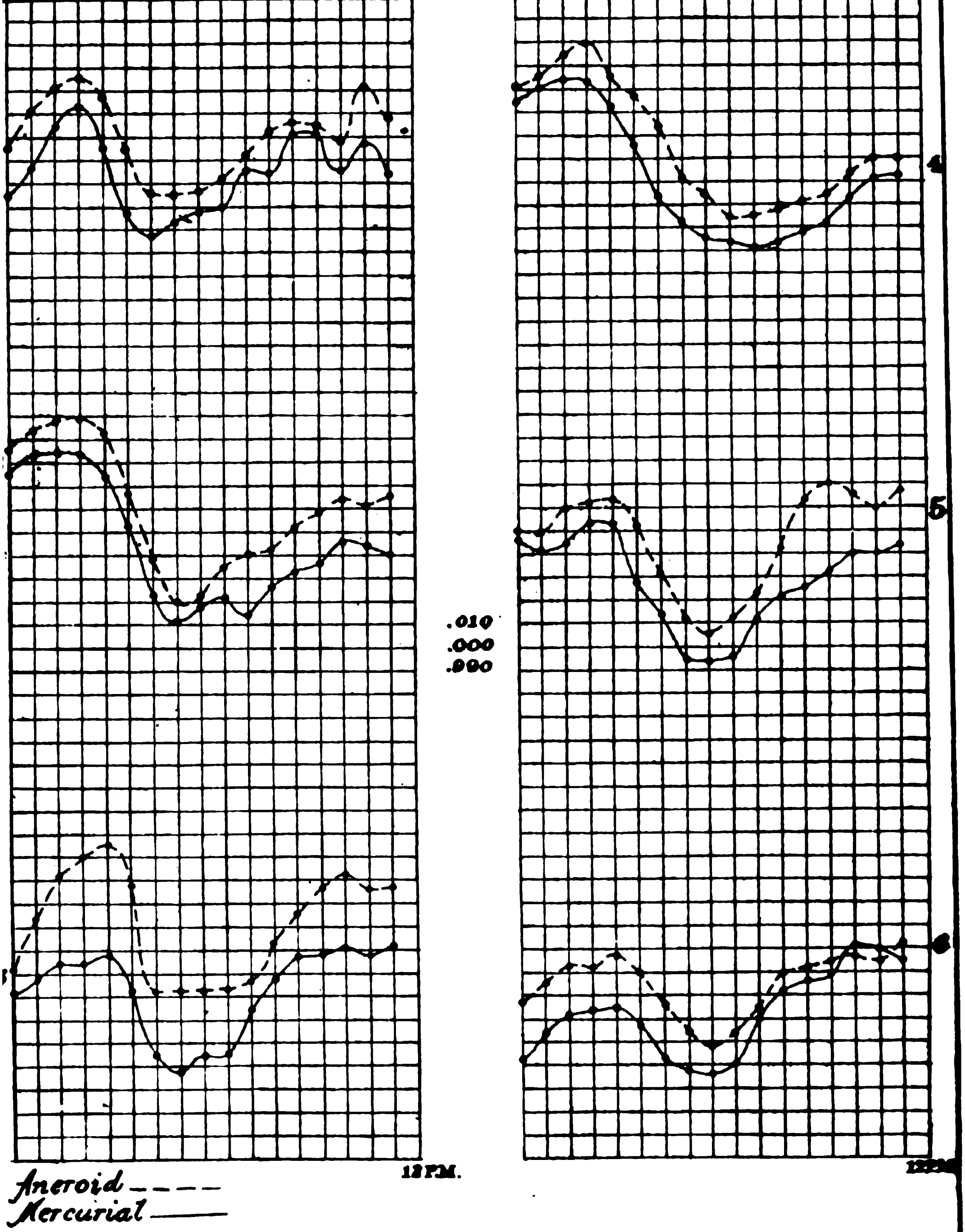
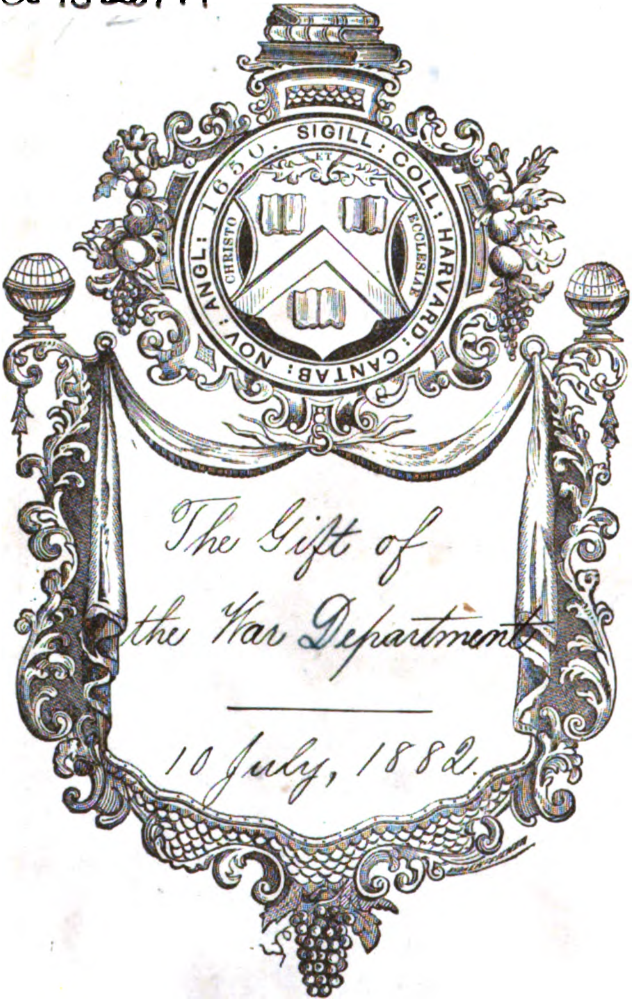


COMPARISON.

Annual reports of the War Department

United States. War Dept

Sci 1520.71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The Gift of
the War Department

10 July, 1882.

47TH CONGRESS, 1st Session. } HOUSE OF REPRESENTATIVES. { Ex. Doc. 1, pt. 2, vol. II.

ANNUAL REPORT

OF THE

CHIEF OF ENGINEERS,

UNITED STATES ARMY,

TO THE

SECRETARY OF WAR,

FOR

THE YEAR 1881.

IN THREE PARTS.

PART I.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1881.

Sci 1520.71

1882 July 19
Gift of
The War Dept.

[EXTRACT FROM THE ANNUAL REPORT OF THE SECRETARY OF WAR.]

WAR DEPARTMENT,
November 10, 1881.

* * * * * * *

I invite especial attention to that part of the report of the Chief of Engineers which refers to our sea-coast defenses. For many years, during which no work whatever has been done upon these defenses except for their preservation and repair, under small appropriations confined to these purposes by law, the Chief of Engineers has called attention in his annual reports to the very great danger which results from leaving our fortifications in their present condition.

The casemated works, which necessarily form a large part of our sea-coast defenses, were built before the invention of modern armor, and before the introduction of rifled guns into maritime warfare. They are built of masonry, unprotected by armor, and although in their day they were equal to any in the world, they are utterly unfitted to withstand the assaults of modern ships of war.

The Chief of Engineers shows that a defense by fortifications and torpedoes is the only one which is at all practicable for coasts as extended as ours, comprising so many rich maritime cities, extensive navy-yards, and depots of supply; that any attempt at any other mode of defense would be enormously expensive both for first cost and cost of maintenance, and that it is the only mode adopted by maritime nations.

Experience shows that modern wars come on suddenly; that serious international disputes occur between nations the relations of which are apparently the most unlikely to be other than friendly, and that a condition of readiness for defense and an attitude of belligerency are sometimes the best preventives of actual war. We know that the necessary new works and the proper modifications of our old works will require many years for their completion, and it seems simply a matter of common prudence that we commence without delay, and under liberal appropriations, to put our coasts in an efficient condition of defense.

I also commend attention to that part of the report of the Chief of Engineers which speaks of the needs of our torpedo system, and the importance of increasing the strength of the Engineer Battalion to 520 men, the minimum number consistent with reasonable efficiency. The work of engineer troops is more technical than is required in any other part of the Army, and while this is so, they are regular soldiers, thoroughly instructed in infantry tactics, and are as available in an emergency as any other troops of the line for any duty that may be required of soldiers. On our torpedo service much will depend in future wars, and 520 men in training for that service, for all our coasts and all our harbors, seems but a small number, and the desire of the Chief of Engineers for an increase of 320 men above the 200 to which the battalion is limited by orders, under the reduction of the Army to 25,000 men, is a reasonable one, and should be granted. No increase of officers is necessary, simply a provision of law authorizing the recruitment of the Engineer Battalion by the number necessary to raise its strength to 520 enlisted men, this number to be in addition to the 25,000 men who now constitute the entire Army, if my recommendation for a repeal of recent restrictions as to the enlisted force of the Army is not concurred in. The maximum strength of the battalion, as authorized by existing law, is 752, or 232 more than the strength recommended.

The funds applied to the improvement of rivers and harbors during the past fiscal year were derived from the appropriation of June 14, 1880, and balances remaining unexpended of previous appropriations, the total amount available for expenditure on July 1, 1880, being $13,549,455.41. To the above should be added certain small amounts from the appropriation of March 3, 1881, which were made available before the commencement of the present fiscal year. Operations have been carried on under approved projects for the improvements to which they relate, with results which have been generally satisfactory. Detailed information in regard to the various works in progress during the year will be found in the report of the Chief of Engineers.

The preliminary arrangements which were in progress at the date of last annual report for making a practical test of the flume invented by Mr. M. J. Adams for increasing the depth of water in the Mississippi River, for which the sum of $20,000 was provided by act of March 3, 1879, have been continued during the fiscal year, under the direction and supervision of the inventor.

The surveys and examinations of rivers and harbors, called for by the act of March 3, 1881, are in process of execution, and it is expected that the reports and maps will be ready for transmission to Congress in the early part of the session.

The Mississippi River Commission has been engaged in the further prosecution of surveys of the river and its tributaries, and in considering plans for the improvement of the main river, and in making the necessary arrangements for the application of the appropriation of $1,000,000 in the river and harbor act of March 3, 1881, for the improvement of the river below Cairo. Reports from the commission will be found appended to the Report of the Chief of Engineers.

On the survey of the northern and northwestern lakes, a new chart of the west end of Lake Erie has been completed and published. The final report of this survey is now in course of preparation.

In the survey of the territory of the United States west of the one hundredth meridian work has been confined to the reduction of notes and the construction of maps. Six atlas sheets have been completed.

Volume VII, the last of the quarto reports of the fortieth parallel survey, has been published.

Eight officers of the Corps of Engineers have been on duty at the headquarters of the military divisions and departments, and have been engaged in making such surveys and preparing such maps as are required for the use of the Army. The maps prepared by these officers are of great value in the movement of troops, and the establishment of posts for controlling the Indians and protecting settlers. There is a great demand for the maps from citizens for use in the location of railroads, mines, and valuable lands. The small appropriation asked for the next fiscal year for continuing these surveys and for publication of maps required for military purposes is earnestly recommended.

* * * * * * *

Improvement of the South Pass of the Mississippi River.—The last annual report from this department brought the history of this work to August 9, 1880, when there had been from July 8, 1879, a full year's maintenance of the channel required by law, after excluding days of non-maintenance, all of which occurred in the first two quarters. Uninterrupted maintenance was continued for the two quarters ending February 9, 1881. The engineer's certificate for the succeeding quarter showed that there was full maintenance, excepting through the pass itself, in which, as measured from the plane of the established gauge-mark, there was a slight failure for a distance of 240 feet; but during the time in question the stage of the river was such as to make its actual level, at low tide, 1.2 feet higher than the established low-water mark, so that the required channel was in fact maintained during the quarter. The facts being submitted by me to the Attorney-General for his opinion as to whether Mr. Eads was entitled to payment for maintenance during the quarter ending May 9, 1881, he answered in the affirmative, and payment was made accordingly. The next quarter extended to include August 13, 1881, four days being excluded in computation on account of the channel being in that time reduced to 110 feet in width at one point and given the required width by dredging. Four quarterly payments of $25,000 each for the maintenance, and two semi-annual payments of $25,000 each for interest on the $1,000,000 retained, have accordingly been made to Mr. Eads.

The total expenditures of the government up to this time, on account of this improvement, are $4,550,000. It will be seen that there has been a substantial maintenance of the prescribed channel during the eighteen months last past, with a loss of only four days, and that the remarks in my predecessor's report concerning the permanency of this work are confirmed, to a large extent, by the results obtained during the second year of successful operation of this remarkable improvement.

* * * * * * *

REPORT

OF

THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

REPORT

OF

THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., October 22, 1881.

SIR: I have the honor to present for your information the following report upon the duties and operations of the Engineer Department for the fiscal year ending June 30, 1881.

OFFICERS OF THE CORPS OF ENGINEERS.

The number of officers holding commissions in the Corps of Engineers, United States Army, at the end of the fiscal year was 106 on the active list and 7 on the retired list; the latter, however, under the law of January 21, 1870, not being available for duty. In the duties devolving upon the Corps by law and by its organizations, the employment of a number of scientists and assistant engineers has been necessary.

Since the last annual report the Corps has lost by death, resignation, and retirement, three of its officers: Capt. Charles B. Phillips, who died at Norfolk, Va., June 14, 1881; Lieut. Samuel E. Tillman, who resigned, to date December 31, 1880; and Col. John G. Barnard, who was retired January 2, 1881, in conformity with provisions of section 1244, Revised Statutes, being over sixty-two years of age, and having served over forty-five years as a commissioned officer.

There have been added to the Corps, by promotion of graduates of the Military Academy, two second lieutenants and three additional second lieutenants, whose commissions date from June 11, 1881, but who did not become available for duty till after the close of the year, and are, therefore, not included in the strength of the Corps.

On the 30th June, 1881, the officers were distributed as follows:

On duty, Office Chief of Engineers, including the Chief	4
On duty, fortifications	1
On duty, fortifications and light-house duty	1
On duty, fortifications and river and harbor works	13
On duty, fortifications, river and harbor works, and light-house duty	1
On duty, fortifications, river and harbor works, and "The Mississippi River Commission"	1
On duty, Board of Engineers	1
On duty, Board of Engineers and river and harbor works	1
On duty, Board of Engineers, fortifications, and river and harbor works	3
On duty, Board of Engineers, Battalion of Engineers and fortifications	1
On duty, Board of Engineers, and light-house duty	1
On duty, river and harbor works	27
On duty, river and harbor works and light-house duty	3
On duty, river and harbor works, light-house duty and "The Mississippi River Commission."	1
On duty, survey of northern and northwestern lakes, and "The Mississippi River Commission."	1

On duty, jetties at mouth of Mississippi River, fortifications and light-house duty.	1
On duty with Battalion of Engineers	11
On special duty in Europe	1
On staff of General commanding Department and on river and harbor works	1
On duty, construction of building for State, War, and Navy Departments; Washington Aqueduct, and construction of Washington National Monument	1
On duty, fortifications, river and harbor works, and in connection with Centennial celebration and Monument at Yorktown, Va	1
Detached on duty with the General of the Army, Generals commanding divisions and departments, Light-House Establishment, Military Academy, the Board of Commissioners of the District of Columbia, "The Mississippi River Commission," and on special duty in Europe	30
	106

The officers detached were on duty as follows:

Col. William F. Raynolds, engineer fourth light-house district	1
Lieut. Col. J. C. Duane, engineer third light-house district	1
Maj. O. M. Poe, on staff of the General of the Army	1
Maj. O. E. Babcock, engineer fifth light-house district	1
Maj. P. C. Haines, engineer sixth light-house district	1
Maj. F. U. Farquhar, engineer secretary to Light-house Board	1
Maj. W. J. Twining, Engineer Commissioner District of Columbia	1
Capt. D. P. Heap, Delegate of United States to Electrical Exhibition at Paris, France	1
Capt. W. A. Jones, on staff of Major-General commanding Division of the Pacific.	1
Capt. W. R. Livermore, on staff of commanding General Department of Texas	1
Capt. W. S. Stanton, on staff of commanding General Department of the Platte	1
Capt. J. F. Gregory, on staff of Lieutenant-General, Division of the Missouri.	1
Capt. Geo. M. Wheeler, in connection with International Exhibition of Geography at Venice, Italy	1
Capt. J. B. Quinn and Lieut. W. L. Marshall, in charge and disbursing officers of works under "The Mississippi River Commission"	2
Capt. C. W. Raymond and Lieut. H. S. Taber, on duty with Company E, Battalion of Engineers, and at Military Academy	2
Capt. Clinton B. Sears and Lieuts. J. G. D. Knight, Eric Bergland, Dan C. Kingman, Willard Young, S. W. Roessler, and J. L. Lusk, on duty at the Military Academy	7
Lieuts. R. L. Hoxie and F. V. Greene, assistants to Engineer Commissioner of the District of Columbia	2
Lieut. C. F. Palfrey, on staff of commanding General Department of Arizona	1
Lieut. T. N. Bailey, on staff of commanding General Department of the Missouri.	1
Lieut. T. W. Symons, on staff of commanding General Department of the Columbia	1
Lieut. S. S. Leach, secretary and disbursing officer of "The Mississippi River Commission"	1
	30

SEA-COAST AND LAKE-FRONTIER DEFENSES.

During the past fiscal year work upon our sea-coast defenses has been limited, in accordance with the terms of the act of March 3, 1881, to their protection, preservation, and repair.

It is again my duty to invite attention to the importance of early and reasonable expenditures on our sea-coast defenses, but I can make no better exposition of the necessity of a *commencement*, if nothing more, in the modification of, and additions to, our works of fortifications on which the safety of our maritime cities, our navy-yards, and depots of supply must sooner or later depend, than by repeating the views which were presented in my last annual report.

For many years no appropriations whatever have been made for the construction of new works, or for the modifications of the old works which were built before the introduction of modern ordnance and armored ships, and which latter, although there were none better in their day, are now most of them utterly unfit to cope with modern ships of war. The earthen batteries more recently built in the positions which are available for such batteries in our harbors are generally in effective condition, though by reason of the late increase in the power of ordnance some of them should be strengthened by thickening the parapets and coverings of magazines.

The casemated works of which our sea-coast defenses are necessarily largely composed were built when wooden walls were the only protection of guns afloat. Now, ships of war are clad in armor up to two feet in thickness, and the old smooth-bores have been replaced by rifled guns, the largest of which throw shot of nearly a ton's weight and which burn at each discharge nearly a quarter of a ton of powder.

While other maritime nations are adding to their already powerful navies heavily armored ships of war, which are armed with 81 and 100-ton guns and which cost, exclusive of armament, more than two and a half millions of dollars, they are building armored defenses for the protection of their own coasts. Great Britian has already more than 500 guns in position behind armored defenses.

We have not one such gun, nor have we any armored defenses whatever.

I think it is plainly demonstrated in the remarks which follow, taken from my last annual report, not only that reliance can be placed on no other mode of defense of our sea-coast, but that fortifications and torpedoes furnish the most efficient, most enduring, and least expensive mode of such defense; and I earnestly hope that Congress may be induced to grant for the next fiscal year a reasonable amount for the resumption of work on our sea-coast defenses.

In this connection I invite attention to the summary of the report of The Board of Engineers, page 56, and to the letter from Lieut. Colonel Gillmore, of the Corps of Engineers, who has devoted much attention to the subject of sea-coast defenses, which will be found in Appendix No. 2, page 399.

> The United States, separated from the rest of the world by wide oceans, pursuing towards all nations a policy strikingly characterized by its pacific tendency, its impartiality and justice; contracting no political alliances; confining her intercourse with the rest of the world rigidly to the letter of such temporary arrangements as are dictated by reciprocal commercial interests, might, at first view, be regarded as too remote physically, and as politically too insulated, to be endangered by the convulsions which, from time to time, disturb the nations of the earth.
>
> Neither our geographical position, however, nor our forbearance, nor the equity of our policy, can always avail us under the relation in which it is our destiny to stand to the rest of the world.
>
> Experience has shown that even the intercourse of traffic, much as it conduces to our prosperity, can be indulged only at the risk of obliging the nation occasionally to assume a belligerent attitude, and of surrendering to the spirit of contention—which seems to govern nations as it does the natural man—a portion of its fruits. The certainty of the return of periods of embarrassment and strife with foreign nations similar in their origin to those which have visited this nation, affords a sufficient reason of itself for securing ourselves in the best manner against the more serious evils of these unavoidable collisions.
>
> No one acquainted with our history can hesitate to ascribe much of the wantonness and duration of the wrongs we have endured to a knowledge on the part of the nations of the scantiness and inefficiency of our military and naval forces. It is certain that in our present condition injuries to our citizens abroad and insults to our flag could not be resented with that vigor and promptitude demanded by the dignity and honor of the nation, and justified by a knowledge that our fine harbors, important navy-yards, rich commercial cities, and depots for military and naval stores were guarded by impregnable fortifications and obstructions.
>
> It concerns the honor of the United States, when involved in controversy with other powers, to be able to appeal to the sword, but that appeal should be accompanied by the consciousness that the weapon appealed to would not be inferior to that held by the adversary. This relation of inferiority may at present exist though the adversary be a comparatively weaker power.
>
> When the great change in ships and their armaments was initiated after the com-

mencement of our late civil war, Great Britain did not hesitate to appropriate $40,000,000 for the defense of its most important harbors, and we may well profit by her example. There is nothing so costly to a nation as a lack of preparation for war. In fact, to be prepared for war will often prevent it; and though we may not feel the daily imminence of war with great foreign powers, as England did, yet with incomplete or inadequately armed defenses for our great sea-port cities, even the *attitude* of belligerency, which we not unfrequently have to assume, has not the imposing effect it should have, nor is it accompanied with a justly founded self-confidence on our own part. The neglect of suitable preparation cost France many millions of treasure, a portion of her territory, and a great humiliation. The same must inevitably happen to the United States if it does not push forward its coast defenses and provide them with guns like those possessed not only by the great powers, but even by smaller nations.

"It is upon our maritime frontier that we are most exposed. Our coast for three thousand miles is washed by the ocean which separates us from those nations who have made the highest advances in all the arts, and particularly in those which minister to the operations of war, and with whom, from our intercourse and political relations, we are most liable to be drawn into collision. If this great medium of communication, the element at the same time of separation and of union, interposes peculiar obstacles to the progress of hostile demonstrations, it also offers advantages which are not less obvious, and which, to be successfully resisted, require corresponding arrangements and exertions. These advantages depend on the economy and facility of transportation, on the celerity of movement, and on the power of an enemy to threaten the whole shore spread out before him, and to select his point of attack at pleasure. A powerful hostile fleet upon the coast of the United States presents some of the features of a war where a heavy mass is brought to act against detachments which may be cut up in detail, although their combined force would exceed the assailing foe. Our points of exposure are so numerous and distant that it would be impracticable to keep, at each of them, a force competent to resist the attack of an enemy prepared by his naval ascendency and his other arrangements to make a sudden and vigorous inroad upon our shores. It becomes us, therefore, to inquire how the consequences of this state of things are to be best met and averted."*

In the event of war with a maritime nation, if we had no well-digested system of fortifications ready for use, the cruisers and war vessels of the enemy could run into our harbors, and, without landing, could either destroy the property along our shores or else lay our cities under contribution. We have a sea-coast line of more than three thousand miles in extent on the Atlantic and Gulf of Mexico, and one thousand miles on the Pacific, not including Alaska, along both of which lie scattered all the great cities, all the depots of commerce, all the establishments of naval construction, outfit, and repair, and towns, villages, and establishments of private enterprise without number. From these lines of sea-coasts, navigable bays, estuaries, and rivers, the shores of which are similarly occupied, penetrate deep into the heart of the country. The accurate detailed charts of our harbors and channels published by the United States Coast Survey are accessible to all nations and are doubtless in their possession. There are foreign military and naval depots and arsenals in close proximity to our shores, and the arrival of armed vessels will follow in a few days or even hours the declaration of war. Thirty-six hours' steaming could bring them from Halifax; 6 hours could bring them from Havana; and 96 hours from Victoria, Vancouver's Island, could bring them in front of San Francisco, the navy-yard at Mare Island, and the arsenal at Benicia. There might be very little time for preparation to meet the assaults of these fast-running, sea-going, armored ships, ships clad with from 6 to 24 inches of iron armor, carrying rifled guns from 9 inches to 17 inches bore, which are more powerful than any gun we have in our service. With a fleet or even a single vessel of this kind in one of our harbors, it would be of no avail to collect troops in the city or town threatened. Suppose, with our railroad facilities, we could concentrate 100,000 men in 24 hours at the point threatened, of what use would they be against the armored ship? Suppose that in a night the men concentrated could throw up temporary earthworks and mount such guns as might be hastily mounted on improvised platforms, 32-pounders, 42-pounders, 100-pounder rifles (even if it were possible to handle guns of this small size with the rapidity assumed)—what injury could all this do to the armored ship? The projectiles from such batteries would fall harmlessly from the side of the ememy. While lying, if need be, beyond the range even of our guns, with his 800 to 2,000 pounders he would pierce such temporary parapets through and through, dismount the guns, and explode any magazines of a temporary character.

But it may be said that we would mount guns as powerful, and even more powerful than those of the enemy. Doubtless this would be done; first, if we had such guns in our service, and, second, if we had the time.

The only modern guns of which we have any number are 8-inch rifles carrying shot of 180 pounds, fired with 35 pounds of powder, of which there are on hand 110. It is understood that the Ordnance Department has recently obtained appropriations, and has made contracts, for constructing four breech-loading 12-inch rifles on the Krupp plan, which will carry shot of 800 pounds fired with 300 pounds of powder, and that that department will convert the 325 15-inch smooth-bores on hand (which at 1,200 yards are less efficient than the 9-inch rifle) into 11-inch breech-loading rifles, carrying shot of 500 pounds fired with 90 pounds of powder, as soon as Congress may appropriate money therefor.

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* Secretary of War Cass.

Such is our condition for arming our coasts. European governments are rapidly replacing their old armaments by rifled guns of immense calibers, among which are 12-inch rifles, which weigh 38 tons and carry shot of 800 pounds, fired with 130 pounds of powder; and 16-inch rifles, which weigh 80 tons and carry shot of 1,700 pounds, fired with 370 pounds of powder; and they are now making 17-inch rifles, which weigh 100 tons and carry shot of 2,000 pounds, fired with 470 pounds of powder. These are the kinds of guns we must mount in batteries against the armored vessels. But their great weight and size require corresponding dimensions in the batteries in which they are placed, and in the strength and solidity of the platforms upon which they are mounted. The parapets and traverses of earth and sand to protect them must be three and even four times as thick and massive as they were formerly built to resist the armaments of 20 years ago. Where the parapets of earth were but 10 feet in thickness, now they must be 40 feet. Guns that were formerly dragged with ease by 15 or 20 men, and placed in position over night, are now supplanted by armaments of such huge masses that special mechanical appliances are required to move them even slowly, and cannot be lifted upon their supports without the aid of hydraulic power. No matter how many men may be at our disposal, the time required to place the modern armaments in position is vastly greater than for the guns of 20 years ago, and before such works could be improvised in a harbor, the enemy in his armored ships will have accomplished all he desired, and have sailed or steamed for some other harbor to repeat the injuries of the first. But suppose the harbor in question was on the New England coast, and the season of the year the winter—when the ground is frozen hard—then the erection of efficient earthen batteries would be out of the question.

It will require much time and large expenditures to make the necessary modifications of our casemated works, and to complete our barbette and mortar batteries and furnish them with suitable armaments. It would be but an act of prudence to make the beginning without delay. The disasters of the first three months of a war under the present condition of our defenses might cost the nation tenfold the expenditure that would be needed to thoroughly protect our coast against attack. Our great cities, New York, Philadelphia, Boston, San Francisco, New Orleans, Baltimore, and Washington, should they fall into the hands of an enemy, would suffer ten times more than the cost of all the forts necessary to secure them against such disaster. But such reverses would also be great calamities to the nation, crippling its war power.

It was estimated that in the great fire in the city of Boston, in 1872, the property destroyed within a few hours was worth upward of $86,000,000, although the fire was confined to a small part of the city, and did not touch the shipping. Is it easy, then, to estimate the loss that would accrue from the fires that a victorious enemy could kindle by his shells? Or is it easy to overrate the tribute such a city would pay for exemption from that calamity? Can we value too highly the pecuniary losses that the destruction of one of the great navy-yards would involve? and the loss beyond all pecuniary value of stores and accommodations indispensable in a state of war, and which a state of war could hardly replace?

In what way may a powerful enemy wage war against us? He may do so—

1. By attacking our commerce and navigation upon the ocean. As, however, no military preparations on the shore can avert this danger, and the means of meeting it must be purely naval, these means do not now fall under consideration; or,

2. By assailing one or more of the important points of the coast with a large military and naval force, with a view to immediate damage, or more or less protracted occupation; or,

3. By suddenly appearing with a large squadron of vessels before our principal commercial cities, laying them under contribution, and burning or carrying off the shipping, and by making powerful attacks upon our navy-yards in order to destroy those establishments; or,

4. By attacks on smaller towns and establishments of the coast with small squadrons or single vessels, or with privateers, capturing or destroying the shipping therein, and levying contributions, and by like means intercepting the interior commerce within the bays, sounds, and estuaries of the coast; these lesser enterprises being often conducted under the countenance and support of considerable fleets.

The danger may take any of these forms, or all of them. And against any or all of these a naval force of equal or greater strength, if it could with any certainty be found at hand, might be an adequate resort, though it would not be the most economical. But, in the first place, we are yet, and shall be for years, inferior in our naval preparation to nations with which we are likely to be in conflict; and, next, if we were even far superior, it would be impossible to have at each of the points to be guarded a naval force sufficient to secure it, because a hostile squadron of powerful, fast-running armored steamers would fall with equal ease on either of the important points, and could with no more certainty be expected at one than at another; so that, to resist successfully, we must be ready at each and all with a force not less than that of the enemy; if less, an unavailing resistance would but augment the calamitous consequences.

An enemy's squadron, assembled at Halifax or Bermuda, must be equally looked for at every important point, from the Penobscot to New Orleans, inclusive, for it could with equal ease fall upon either. The same would be true, moreover, of such a force assembled in any Atlantic port of Europe.

There has been but one practice among nations as to the defense of ports and harbors, and that has been a resort to fortifications, and obstructions by torpedoes or otherwise. All the experience that history exhibits is on one side only; it is the opposition of forts, or other works comprehended by the term fortifications, to attack by vessels. No nation omits covering the exposed points upon her seaboard with fortifications, nor hesitates in confiding in them.

"All the harbors and inlets upon the coast where there are cities or towns whose situation and importance create just apprehension of attack, and particularly where we have public naval establishments, should be defended by works proportioned to any exigency that may probably arise."*

"After a careful and anxious investigation of a subject involving in so high a degree the safety and honor of the country, I fully concur in the opinions expressed by the Board of the superiority of permanent works of defense over all other expedients that have yet been devised, and of their absolute necessity if we would avoid the danger of defeat and disgrace—a necessity rather increased than diminished by the introduction of steam batteries and the use of hollow shot. It would, in my opinion, prove a most fatal error to dispense with them, and to rely upon our Navy alone, aided by the number, strength, and valor of the people, to protect the country against the attacks of an enemy possessing great naval means. To defend a line of coast of three thousand miles in extent, and effectually to guard all the avenues to our great commercial cities and important naval depots, the Navy of the United States must be very superior to the means of attack of the most powerful naval power in the world, which will occasion an annual expense this country is not now able to bear; and this large naval armament, instead of performing its proper function as the sword of the State in time of war, and sweeping the enemy's commerce from the seas, must be chained to the coast or kept within the harbors.

"It has been clearly demonstrated that the expense of employing a sufficient body of troops, either regulars or militia, for a period of even six months, for the purpose of defending the coast against attacks and feints that might be made by an enemy's fleet, would exceed the cost of erecting all the permanent works deemed necessary for the defense of the coast. One hundred thousand men divided into four columns would not be more than sufficient to guard the vulnerable points of our maritime frontier, if not covered by fortifications. An amount of force against an expedition of 20,000 men, which, if composed of regulars, would cost the nation $30,000,000 per annum, and if militia about $40,000,000; and, supposing only one-half the force to be required to defend the coast with the aid of forts properly situated and judiciously constructed, the difference of expense for six months would enable the government to erect all the most necessary works. This calculation is independent of the loss to the nation by abstracting so large an amount of labor from the productive industry of the country, and the fearful waste of life likely to result from such a costly, hazardous, and harassing system of defense.

"It must be recollected, too, that we are not called upon to try a new system, but to persevere in the execution of one that has been adopted after mature deliberation, and that is still practiced in Europe on a much more extensive scale than is deemed necessary here; so much more so that there exist there single fortresses, each of which comprises more extensive and stronger works than is here proposed for the whole line of our maritime frontier. We must bear in mind, also, that the destruction of some of the important points on that frontier would alone cost more to the nation than the expense of fortifying the whole line would amount to, while the temporary occupation of others would drive us into expenses far surpassing those of the projected works of defense.

"The organization of permanent defenses proposed by the Board for our frontiers is not upon military and naval considerations alone, but is calculated to protect the internal navigation of the country. The fortifications proposed, at the same time that they protect our coast from the danger of invasion, and defend the principal commercial avenues and naval establishments, cover the whole line of internal navigation, which, in time of war, will contribute in so essential a manner to the defense of the country by furnishing prompt and economical means of transportation; so that while the main arteries which conduct our produce to the ocean are defended at their outlets the interior navigation, parallel to the coast, is protected, and a free communication kept up between every part of the Union."*

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* Secretary of War Cass.

It is truly an axiom in military science, and one fully illustrated by military history, that the worst mode of waging war, although strictly defensive, is to allow its field of action to be within the borders, and that the best is that which most frequently assumes an offensive attitude. In our case, war can only be excluded from our territory by fortifications, and we can only assume the offensive through our Navy. The construction of the former secures the means of creating, equipping, and repairing the latter, and leaves it unincumbered with duties which it imperfectly performs, to the full exercise of its important and appropriate functions.

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It may be asked what use will there be in fortifying but compratively a small number of our harbors when the enemy can land at hundreds of other places on our coasts. It is true that, in comparison with the length of our seaboards, the system of defense by permanent fortifications has so far contemplated but a few of the harbors and cities, to wit, the Penobscot and Kennebec Rivers; the harbors of Portland, Portsmouth, N. H., Boston, and New Bedford; Narragansett Bay; the harbors of New London and New York; Delaware River; the harbor of Baltimore, and approaches to THE CAPITAL *via* the Potomac River; Hampton Roads; the harbor of Beaufort, N. C.; the mouth of the Cape Fear River; the harbors of Charleston and Savannah; Cumberland Sound; the harbors of San Augustine, Key West, Dry Tortugas, and Mobile; Ship Island, Mississippi Sound; the mouth of the Mississippi and the other approaches to New Orleans; the harbor of Galveston; the bays of San Diego and San Francisco; and the mouth of the Columbia, less than thirty in all, but most of them have sufficient depth of water to admit the entrance of armored vessels, carrying powerful rifled ordnance; they contain all of our navy-yards, and include the main objects of the enemy.

"Although it would appear on a superficial view to be a gigantic and almost impracticable project to fortify such an immense extent of coast as that of the United States, and difficult, if not impossible, to provide a sufficient force to garrison and defend the works necessary for that purpose, yet the statements contained in the reports of the Board remove these objections entirely. The coast of the United States throughout its vast extent has but few points which require to be defended against a regular and powerful attack. A considerable portion of it is inaccessible to large vessels, and only exposed to the depredations of parties in boats and small vessels of war; against which inferior works and the combination of the same means and a well organized local militia will afford sufficient protection. The only portions which require to be defended by permanent works of some strength are the avenues to the great commercial cities and naval and military establishments, the destruction of which would prove a serious loss to the country, and would be regarded by an enemy as an equivalent for the expense of a great armament. It is shown, also, that the number of men required, on the largest scale, for the defense of these forts, when compared with the movable force that would be necessary without them, is inconsiderable. The local militia, aided by a few regulars and directed by engineer and artillery officers, may, without previous training, be safely intrusted with their defense in time of war."*

Of all the circumstances of danger to the coast the chance of an attempt by an enemy to land and march any distance into a populous district is least to be regarded, whether there be or be not speedy mode of receiving re-enforcements, and our system of fortifications has little to do with any such danger. In preparing against maritime assaults the security of the points to be covered is considered to be greatly augmented whenever the defense can be so arranged as to oblige an enemy to land at some distance; for the reason that opportunity is thereby allowed, in the only possible way, for the spirit and enterprise of the people to come into play.

Instead of being designed to prevent a landing upon any part of the coast, as many seem to suppose, and some to allege in proof of extravagant views on the part of the system of defense, the system often leaves this landing as an open alternative to the enemy, and aims so to cover the really important and dangerous points as to necessitate a *distant* landing and a march towards the object through the people. It is because the expedition would otherwise easily accomplish its object without landing, and without allowing the population to partake in the defense, that the fortifications are resorted to. For instance, without forts low down in Delaware Bay, an enemy could place his fleet of steamers in front of Philadelphia by the time his appearance on the coast had been well announced throughout the city, and in spite of all New Jersey, Delaware, and Lower Pennsylvania, he could levy his contributions, and burn the navy-yard and shipping, and be away in a few hours. But being obliged by the forts above mentioned to land full 40 miles below the city, the resistance to his march may be safely left to the courage and patriotism that will find ample time to array themselves in opposition.

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* Secretary of War Poinsett.

A distant landing is deemed to be a great advantage to the defense in all cases; and in populous districts, if the forts be sufficient for this particular duty, it makes the security complete.

It is no part of the task assumed by the system of fortifications, as has just been stated, to guard against the invasion and protracted occupation of a well-peopled district, or of a point around which the forces of the country could soon be rallied. But there are places important in themselves, or necessary to the general welfare, that have not the advantage of a large population at hand or within call, and which may nevertheless be very tempting objects to an enterprising enemy. The harbors of the Dry Tortugas and Key West, and the navy-yard at Pensacola will, for instance, in time of war, be of infinite value in reference to the commerce of the Gulf of Mexico. Their destruction would therefore be a great object with a maritime enemy, and must depend wholly on the strength and state of readiness of their defenses. The same may be said of Forts Jackson and Saint Philip, on the Mississippi, 73 miles below New Orleans. They are surrounded by vast morasses and swamps, and are almost entirely inaccessible by land from any direction.

"There are, no doubt, certain points less equal to self-defense than others, and where the preparation must be greater. Of this class is the delta of the Mississippi, not only in consequence of its many avenues of approach, but because its great natural highway does not at present allow those lateral supplies of the *personnel* which, from geographical formation, and from the state of the settlements, can be speedily thrown upon most other points of the country."*

"Although this department is fully aware of the importance of affording permanent and as perfect protection as may be possible to the whole coast, it regards that section embraced by the shores of the Gulf of Mexico as the most exposed and the most important. It is true that the coast to the eastward of Cape Hatteras possesses points that may attract the attention of an enemy, and that, in the present state of things, the chances of success would justify a hostile enterprise, and are much greater than a wise provision would allow to exist. It is equally so that, however difficult of access the coast may be from Cape Hatteras to Florida, the nature of a part of its population, and the facility afforded to an enemy, by its present neglected condition, to blockade and annoy the principal outlets of the valuable exports of that important portion of our country, require our early attention; still, the means of defense from Maine to Florida may be united together, and the parts may afford mutual succor to each other. But the coast of the Gulf of Mexico, on the contrary, is insulated and apart, and must depend altogether upon its own resources. It constitutes the maritime frontier not only of Louisiana, Mississippi, Alabama, and of West Florida, but of Arkansas, Tennesee, Kentucky, Ohio, Missouri, Indiana, and Illinois, and the Territories of Wisconsin and Iowa, embracing nearly three-fourths of the territory of the United States; and it must be borne in mind that the evils which would result from the temporary occupation of the delta of the Mississippi, or from a successful blockade of the coast of the Gulf of Mexico, would not only injure the prosperity of these States, but would deeply affect the interests of the whole Union; and no reasonable expense, therefore, ought to be spared to guard against such a casualty.†"

Our fortifications and torpedoes, then, must close all of our important harbors against an enemy, and secure them to our military and commercial marine; second, must deprive an enemy of all strong positions where, protected by naval superiority, he might fix permanent quarters in our territory, maintain himself during the war, and keep the whole frontier in perpetual alarm; third, must cover the great cities from attack; fourth, must prevent, as far as practicable, the great avenues of interior navigation from being blockaded at their entrances into the ocean; fifth, must cover the coastwise and interior navigation; and sixth, must protect the great naval establishments. In these places are to be found objects that are in every sense of the highest value. On the one hand we see accumlations of military and naval material, and structure for naval accommodation that could not be replaced during a war, which are of indispensable necessity and of great cost; and on the other hand the untold wealth of great cities. As these objects must be great in the eyes of the enemy—great for him to gain and for us to lose—corresponding efforts on his part must be looked for and guarded against.

There should now be stated, in a few words, our system of sea-coast defense, a system steadily pursued from the first by this department, but modified from time to time as new improvements in attack and defense of coasts have been introduced.

Fortifications must command from the shores exterior to our harbors all the waters from which the enemy can reach our cities and navy-yards with his shot and shell; the harbor mouths, and all the narrow passes within them, must also be occupied, and if nature has not afforded all the positions deemed requisite, others must, if practicable, be formed artificially. Fortifications should succeed each other along the channels of approach and in our harbors, so that the enemy may nowhere find shelter from our fire while lying within our harbors, should he succeed in passing the outer lines of works. The harbor mouths and channels must be obstructed by lines of electrical torpedoes for holding the enemy's vessels under fire of the fortifications, previously constructed and stored in the latter, and laid, on the advent of war, in systems, the plans of which have been carefully elaborated in time of peace, by studies of the local charts and tidal currents, each harbor having its own system recorded in this department. The wires, for conducting the current from the electric apparatus on shore, must at the same time be laid securely in subterranean galleries carried out to deep water, and the electric machines themselves—the hearts of the torpedo system—must be placed in chambers within the fortifications, hidden from the enemy, and secured beyond all peradventure from his direct and curved fire. These galleries and chambers must be covered with heavy masonry arches and great masses of earth, and the former, to be efficient, must be indurated, and the latter compacted by time. The torpedo lines must be served by officers selected from the Engineers and the Artillery, assisted by detachments from a Torpedo Corps of intelligent and skilled engineer soldiers, and both officers and men must be thoroughly instructed in the theory and practice of electricity and torpedo obstructions; for they must know how to render the torpedoes instantly harmless for our own vessels, or active against an enemy's.

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*Secretary of War Cass.

†Secretary of War Poinsett,

Heavy mortars must be placed in large numbers to command all those positions where an enemy is likely to anchor within their range, either for the purpose of tampering with, or destroying our torpedo lines, or shelling our cities and public depots of military and naval supplies. The efficiency of mortar batteries against shipping is acknowledged by all military engineers; it is fully appreciated by the navies of all nations, and they are comparatively inexpensive.

Our guns and mortars must be capable of piercing the sides of his iron-clads and of breaking in his decks, and they must be mounted in numbers sufficient to make it impossible for any of his fast-running war steamers to get past our works.

The method of defense by fortifications and torpedoes—torpedoes for holding the enemy's vessels exposed in front of the fortifications, and fortifications for (among their other duties) protecting their torpedo lines, is the most efficient and the least expensive one that can be devised. The cost of such vessels as the British ship *Inflexible*—4 guns—as we learn from a recent government publication, is not less than $900,000 per gun,* while the cost of permanent fortifications need not average one-tenth of that amount.

The cost of repair of the British iron-clads in 1873–'74 ranged from $20,000 to $50,000 per annum each,† while the cost of repair of permanent fortifications is comparatively trifling.

Only a small number of our existing fortifications are what may be called new, that is, planned in accordance with the requirements for resisting modern heavy ordnance, and these works are in all cases earthen barbette batteries. Nearly all of the other works have been handed down to us from former periods, when small guns and wooden ships were to be contended with, some of them even dating back into the last century. But the great powers of Europe do not place their reliance for maritime defense on barbette batteries. They believe in, and are constructing, casemated forts, some of which are provided with wrought-iron scraps and others with iron casemate shields, to protect the guns and the gunners serving them from direct and curved fire. This department, while recommending and urging the construction of barbette batteries for the partial defense of some of our most important harbors, and the entire defense of others of less importance which are in some degree protected by the shallow water of the channels leading to them, has always insisted that the efficient service of heavy guns mounted in these batteries requires very high parapets and depressing or counterpoise carriages—carriages which can be lowered under cover of the parapets while being loaded. It has also foreseen from the time of the introduction of modern armor and ordnance, which commenced durng our late civil war, that the iron plating of ships must lead to the iron plating of forts; and that, as there is a limit to the weight of armor a ship can carry, while there is practically no limit to the weight a fort may bear, forts must retain the supremacy they have always had. The department has therefore looked forward to the conversion of those of our casemated works which would admit the change, for the reception of guns of the heaviest calibers and for armor plating,* and, in some instances, to the construction of new works.

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* The *Inflexible*, the *Dreadnought*, and the *Alexandra* are among the latest examples of British armored ships. The *Inflexible* and the *Dreadnought* are double-turret ships, the former carrying an armament of four (4) 81-ton guns, and the latter an armament of four (4) 38-ton guns. The *Alexandra* is a broadside armored ship, carrying an armament of twelve guns of smaller calibers, viz, two (2) 25-ton guns and ten (10) 18-ton guns.

"The *Inflexible* is estimated to cost £521,750, the *Dreadnought* £508,395, and the *Alexandra* £521,500."—*King's European Ships of War*, 1877.

† "Here it will be seen that in 1873–'74 the largest expense was incurred for the repair of iron-clads. It is also worthy of remark that a small number of vessels only was dealt with, as a reference to the accounts would prove. Thus, in that year alone the *Achilles* cost £24,907; the *Bellerophon*, which had cost nearly £30,000 in 1870, was again, in 1873, charged with an expense of £40,395; the *Minotaur* cost, in this year, £16,681; the *Northumberland*, £10,255; the *Resistance*, £31,637, and the *Warrior* the large sum of £50,000."—*King's European Ships of War*, 1877.

From 1869 to 1875, while appropriations for coast defense were granted by Congress, much progress was accomplished in our earthen batteries, and various modifications were made in the plans of these batteries by which their strength was greatly increased, by adding to the thickness of parapets; by frequently interposing high and bonneted traverses between the guns to guard from enfilade fire and from splinters; by adding to the combined masonry and earth coverings of magazines; by increasing the heights of the parapets, and by introducing monolithic masses of hydraulic cement concrete for the platforms of the guns in lieu of the granite blocks previously used for this purpose. No appropriations have been made for the construction of fortifications since the latter of the above mentioned years, and the sudden failure of appropriations left these earthen batteries in all stages of incompletion, some just commenced, some nearly finished; and by reason of their incompletion, the storms and the waves have been undoing much of what had been accomplished. The same may be said of the earthen mortar batteries, which were commenced during the same period.

In conclusion: with old casemated works (than which there were none better in the world in their day) designed long before the introduction of the 800 to 2,000 pounder rifled guns into modern warfare; their walls pierced for guns long since out of date; without iron armor or shields, and but partially armed, even with the old ordnance; with old earthworks, some of them built in the last century; with new ones for modern guns and mortars but partially built and rapidly being destroyed by the elements by reason of their incompletion; with gun batteries without guns, and mortar batteries without mortars; with no carriages whatever for barbette guns of large size, except such as require the cannoniers to load from the tops of parapets, from which they can be picked off in detail by the enemy's sharpshooters; with an excellent defensive torpedo system developed at our torpedo school at Willets Point, but only partially carried into effect; with but a very small number of our works prepared with the torpedo casemates and galleries necessary for securing the electrical apparatus from the enemy's fire, and for conducting the electric wires to the torpedo lines which must be laid when the day of trial comes, and with less than 200 engineer soldiers educated for torpedo and other engineer service instead of the 752 men now authorized by law, and of whom not less than 520 ought to be ready to supply the detachments required for torpedo duty in our fortified harbors, we can make but a feeble defense against the powerful fleets now prepared and rapidly increasing, which will sooner or later be brought against us by some of the most powerful maritime nations on the earth, or by others nearer at hand whose offensive naval means exceed our own, and whose powers are not to be despised.

The estimates submitted, based on the several estimates of the officers in charge, exhibit the amounts which are deemed necessary by this department for the commencement, the continuance, or the completion, as the case may be, of the several works of defense during the next fiscal year.

Special attention is invited to the estimate of $100,000 for providing torpedoes to be stored in our fortifications, and planted, on the advent of war, in the channels and fairways of our harbors, and for providing the electric apparatus by which the torpedo lines are to be fired.

The Board of Engineers for Fortifications, referring to this subject, in its annual report for the last fiscal year, says:

> The annual appropriation made for the fiscal year 1880-'81 for providing materials to defend our coasts with submarine mines, &c. ($50,000), has been expended, upon the recommendation of this Board, chiefly in the purchase of torpedo cases and junction boxes to be stored for use in the channels leading to the harbor of Boston. A much larger sum could have been judiciously expended in providing for other important harbors, now quite neglected; and an increase in this appropriation for the coming year is urgently to be recommended. The material is not liable to deteriorate in store, and in the present condition of our sea-coast defenses and of their armaments an

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* We have the assurance that iron plates can be manufactured in this country equal in magnitude, and not inferior in quality, to those which twenty years of experience have enabled the English rolling-mills to turn out.

ample supply of torpedoes is a necessity which cannot be ignored without risk of disaster. Not less than $100,000 should be annually applied to this purpose for several years to come.

It is for procuring and storing torpedoes and such portions of the apparatus as cannot readily be obtained in the event of sudden hostilities that the appropriation is asked.

Special attention is also invited to the item of $200,000 for preparing our most important fortifications for operating torpedo lines, by providing bomb-proof chambers for the electrical apparatus, and the bomb-proof subterranean galleries through which the electric wires are to be carried to deep water; both of these being essential to the operation of the torpedo system of defense in connection with the fortifications themselves. The Board of Engineers for Fortifications remarks on this subject as follows:

> Another matter in this connection demands immediate action. In its last annual report this board pointed out in some detail the necessity for a special appropriation to prepare our forts to serve as operating stations for submarine mines. Without such preparation only a very imperfect use could be made of the materials in store. Unless the electric cables connecting the mines with the casemate containing the batteries, &c., are so introduced as to be secure against bombardment, a single fortunate shot may open the whole channel to the enemy. This would be the condition of Boston to-day, and indeed of most of our great seaports. It is useless to provide mines without also constructing the shafts, galleries, and bomb-proofs necessary for their efficient service. An appropriation of $200,000 would go far towards supplying all our chief forts with these most necessary additions, and the appropriation of that sum is again recommended. The works require time for their construction, and at the outbreak of hostilities this would certainly be lacking.

I beg leave to quote the following extract from the report of the Board of Engineers for Fortifications for the fiscal year 1879–'80, respecting the necessity for increasing the number of enlisted men in the Battalion of Engineers:

> For several years the board has urged in its annual reports the importance of increasing the number of enlisted men of engineers under training to fit them for submarine mining. The legal organization of the battalion provides for 752 enlisted men; but, in consequence of the reduction of the Army, and the necessity for troops on the plains, the force authorized to be enlisted is only 200 men, and of these 50 are stationed at West Point on special duty, which prevents their receiving drill or instruction in this new and important duty assigned by Congress to the engineer troops. We have, therefore, only 150 men, even on paper, who possess any knowledge of the planting or serving of the submarine defenses designed to cover our whole extensive sea-coast. The work is technical, requiring special qualifications and special training not to be found in the soldiers of the other arms of service, nor among the volunteers.
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> This statement is a sufficient reason for increasing our present force; but if additional argument be needed, it is found in the fact that now, in time of peace, Great Britain maintains at Bermuda or Halifax, almost in our own waters, six companies, or probably from three to four times as many engineer soldiers, instructed in torpedo warfare, as we have to depend upon to cover our whole coast from Maine to Alaska.
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> In this connection the board would invite attention to the last annual report of the General of the Army, which suggests providing troops for special needs not connected with service against the Indians, by a law authorizing their recruiting, in addition to the 25,000 men that now constitute the entire Army (except the Signal Service, which is already provided for upon a plan similar to that now suggested). If the importance of this increase were thoroughly understood, it might result in authorizing the minimum number of engineer soldiers (520) needed to be kept under training in submarine mining. No increase in officers, nor change in the legal organization of the battalion would be required, and being regular soldiers, thoroughly instructed in infantry tactics, the men would be as available in any sudden emergency as any other troops in the service.

Upon this subject Lieutenant-Colonel Abbot, commanding the Engineer Battalion and Torpedo School, remarks:

> The torpedo-service is not like that of troops in line of battle, where any blunder by a private is quickly seen and corrected by his officers. There are many small details which must be intrusted to the individual soldiers; errors might be covered up

in the progress of the work, and it is only when the mine is planted that they can be detected; and then hours of precious time must be lost in taking the group from the water to correct some little mistakes which, with trained men, would never occur. Experience with newly-enlisted men at the torpedo school constantly confirms these views. Thoroughly impressed, therefore, with the absolute necessity for trained soldiers in torpedo operations, I feel it incumbent upon me to invite attention to the need of provision for a proper organization.

The following considerations have a bearing upon the subject: Torpedoes are planted by grand groups of 21 mines. To do this properly, requires 3 non-commissioned officers and 23 instructed privates of engineers, and about 40 boatmen, laborers, &c., which it is assumed could be hired in any of our seaports to do the parts of the work requiring no particular knowledge or skill. In important harbors and in times of haste, several grand groups could and should be planted simultaneously; but to arrive at the lowest judicious organization, 26 enlisted men of engineers will be assumed for each seperate channel to be defended. There are 30 such channels in the United States which would call for immediate defense. The minimum force then would be 26×30=780 effective soldiers. The legal war organization of the Engineer Battalion consists of five companies of 150 men each, or 752 men, including 2 staff sergeants. Evidently, therefore, for reasonable efficiency, the full strength should be maintained. Allowing, however, one-third as the maximum safe reduction below this estimate for a peace organization, and we have 520 men who must be kept thoroughly instructed and always available. Considering that in war time these men would be scattered along the whole sea-coast, these engineer troops, besides their duties with torpedoes, must be ready at any time to act as sappers and miners and pontoniers, and to make reconnaissances, and photograph maps with troops in the field; and, finally, that they are equally as available as other soldiers in any sudden emergency occurring in a time of peace calling for a military force, and it would appear that a minimum peace organization of 520 men should be maintained. This number is but little more than one-quarter of the police force of New York City, and is certainly very small compared with the enormous interest intrusted to it—the torpedo defense of the harbors along the whole coast of the United States.

The Board of Engineers for Fortifications in its annual report for the last fiscal year, which will be found further on in this report, again urges the importance of the torpedo service, and the increase of the Battalion of Engineers desired, and I heartily concur in its recommendations, which are thus stated:

> It is the duty of the board to again urge the importance of increasing the number of enlisted men of engineers sufficiently to properly prepare for the service of our submarine mines in war. At present, owing to the reduction of the Army and to the need of troops on the plains, only about 100 men would be available in an emergency, hardly enough to defend the port of New York City. The service is technical, requiring qualifications and training not to be found in details from other arms of the service, or among the volunteers. No change in the organic law creating the Battalion of Engineers is required, but simply a provision authorizing it to be recruited to its full strength (752 enlisted men), in addition to the 25,000 men to which the Army is now limited. The Signal Service is already provided for upon this plan, which has also received the favorable indorsement of the General of the Army in his annual report for 1879. No increase of commissioned officers nor change in legal organization would be needful, and the men being thoroughly disciplined and well drilled as infantry, would be as serviceable in ordinary emergencies as those of any other arm of service.

FORTIFICATIONS.

DEFENSES OF THE NORTHERN FRONTIER.

Fort Wayne, Michigan, in charge of Maj. Walter McFarland, Corps of Engineers.—This work is situated on the west bank of the Detroit River, within the limits of the city of Detroit, and commands the passage of the Detroit River. It is a square bastioned work, commenced in 1841, with a brick and concrete scarp replacing the original timbered scarp, detached parapet on the curtains and faces, an unfinished demilune on the water front, and unfinished water batteries on the up and down stream sides.

Except for slight repairs, no money has been expended upon this work since 1869-'70.

DEFENSES OF THE NORTHERN FRONTIER—Continued.

The masonry of the work is very much in need of repointing, and in some places the brick facing is damaged by the frost to such a degree that it should be relaid.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

Fort Porter, Black Rock, near Buffalo, N. Y., in charge of Maj. Walter McFarland, Corps of Engineers.—This work, commenced in 1842, is situated on the Niagara River, within the limits of the city of Buffalo, and consists of a square stone tower or keep, in ruins, surrounded by a square barbette battery.

The keep was nearly destroyed by fire many years ago, and the entire work is, in its present condition, useless for offense or defense.

By joint resolution of Congress, approved July 11, 1870, published in General Orders 93, July 22, 1870, permission was granted to the city of Buffalo, through its park commissioners, "to improve and beautify the grounds known as Fort Porter, situated in said city, and belonging to the United States, in connection with a public park to be laid out on land adjoining the said grounds, the plans for the same to be approved by the Secretary of War: *Provided*, That this resolution shall not be construed to pass any title in the said grounds, but that the ownership and control of said grounds shall remain entirely in the United States, and shall be subject to such changes and uses for military purposes as the Secretary of War may direct."

Under this authority the larger part of the United States grounds at Fort Porter have been handsomely laid out and improved by the authorities of the city of Buffalo.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

Fort Niagara, mouth of Niagara River, New York, in charge of Maj. Walter McFarland, Corps of Engineers.—This work, commenced in 1839, is situated at the mouth of the Niagara River on the south shore of Lake Ontario, about forty miles from, and east of its western extremity.

It is an irregular work, having one strong land front running nearly north and south, extending from Lake Ontario at its northern extremity, nearly to the Niagara River at its southern extremity.

This front is half bastioned, with detached parapet, demilune, and four casemates for howitzers in each flank.

The rest of the *tracé* is irregular, following the general course of the river and of the lake shore.

The work contains two masonry block-houses, built by the French about 1757, and other buildings begun by the French and finished by the English after its capture by them during the French and Indian war.

No money has been expended on this work since 1871, except for slight repairs.

The masonry of the salient of the scarp wall of the south bastion, taken down in 1870, has been rebuilt, the work extending from the angle 35 feet on the left face and 55 feet on the right face.

Thirty linear feet of the coping has been relaid.

The brick coping of the scarp has been a good deal damaged by the action of the elements, and should be relaid in many places. Funds for this purpose will be furnished from the appropriation for protection, preservation, and repair of fortifications for the current fiscal year.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

DEFENSES OF THE NORTHERN FRONTIER—Continued.

Fort Ontario, mouth of Oswego River, New York, in charge of Maj. Walter McFarland, Corps of Engineers.—This work, commenced in 1839, is situated at the mouth of the Oswego River on its east bank, and on the south shore of Lake Ontario, and lies within the limits of the city of Oswego.

It is a bastioned work, pentagonal in shape, with one front facing the lake, one facing the river, and three land fronts, the middle one of which has a demilune.

The scarp, which is unfinished, is of masonry; the counter-scarp is revetted with timber.

The sallyport passes through the curtain of front 4, which is that one of the three land fronts which lies nearest the river, with bastion D on its left and bastion E on its right. The flanks which cover this entrance are furnished with three casemates each for howitzers.

The faces adjacent to these flanks are partly furnished with scarp galleries loop-holed for musketry.

All the other flanks are to be provided with scarp galleries loop-holed for musketry; but five of them are not yet built.

No money, except for slight repairs, has been expended upon this work since 1872, and its condition is now the same as it was shown to be in the annual report for that year, except that a part of the timber roofing of the coal cellars in the rear of the officers' quarters has decayed and fallen in, and the rest is in danger of doing so.

The work is in an entirely indefensible condition against a determined assault, owing to the fact that the masonry of both flanks of bastions C and B, and of the right flank of bastion A, has been carried up but 4 or 5 feet above the bottom of the ditch, while the masonry of the faces and curtains lying between these flanks has been raised but 12 or 14 feet.

As this masonry when finished would be covered from artillery fire by the earth-works in front of it, the objections usually made to the use of masonry in fortifications do not hold here, and there is no good military reason why this work should not be completed as designed. If it is not completed there will always be danger, when the garrison is ordered off on duty, that the small guard left behind for the protection of the ordnance and other stores may be overcome by a rabble, the work taken, and the stores seized, as was threatened four years ago during the labor riots.

Fifty thousand dollars could be well expended in the completion of this work during the next fiscal year.

With the exception of the construction of the flank casemates on front 4, no preparations whatever have been made for the armament of this work.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$50,000 00

Fort Montgomery, outlet to Lake Champlain, New York, in charge of Col. Henry W. Benham, Corps of Engineers.—This casemated work, commenced in 1841, occupies a strategic point of great importance, and commands the entrance to Lake Champlain from the Richelieu or Saint John River.

The work during the past fiscal year has been confined to such repairs as were deemed most immediately needed to prevent great dilapida-

DEFENSES OF THE NORTHERN FRONTIER—Continued.

tions, and such as could be made within the amount allotted for this fort from the general appropriation for the preservation and repair of fortifications.

The work done consisted mainly in the repairing of the asphalt covering of curtains I., II., IV., and V., along the back of the parade wall, and that of the bastions B, C, D, and E, around the staircases.

The wooden, much-decayed stair roofings of these bastions have been rebuilt and painted. The casemate doors and all the casings of curtains I., II., IV., and V., have also been painted, two coats on the outside and one on the inside, after the doors as far as necessary had been repaired.

In addition some of the depressions in the terreplein have been graded up to the proper level.

Projects for the modification of this work to suit its armament of heavy guns have been prepared by the Board of Engineers for Fortifications, and should be carried out.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$33,000 00

DEFENSES OF THE PENOBSCOT.

Fort Knox, Bucksport, Penobscot River, Maine, in charge of Lieut. Col. C. E. Blunt, Corps of Engineers.—This work, situated at the narrows of the Penobscot River, furnishes a defense for the city of Bangor, 18 miles above, and other towns bordering the river, and renders it available as a secure harbor of refuge for the shipping of the extensive eastern coast.

The work, which was commenced in 1843, consists of a casemated main work and exterior earthen batteries, both requiring extensive modifications. It remains in an unchanged condition, no operations having been carried on during the fiscal year except for the necessary care and preservation of the property.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

DEFENSES OF THE KENNEBEC.

Fort Popham, Kennebec River, Maine, in charge of Lieut. Col. C. E. Blunt, Corps of Engineers.—This casemated work, commenced in 1857, defends the entrance, through the mouth of the Kennebec River, to the rich valley of this river, the cities of Bath and Augusta, and the United States arsenal at the latter place.

The work, which requires extensive modifications, remains in an unfinished condition, no operations having been carried on during the fiscal year, except for the necessary care and preservation of the property.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

DEFENSES OF PORTLAND.

Fort Gorges, Portland Harbor, Maine, in charge of Lieut. Col. C. E. Blunt, Corps of Engineers.—This casemated work, commenced in 1857, is one of the series of forts designed to defend the harbor, and channels leading into the harbor, of the important strategic position occupied by the city of Portland. Its construction was suspended for want of funds in 1876, and the work is in an incomplete condition.

The long suspension of operations causing deterioration, the working plant must be renewed when work is resumed.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year $12,000 00

Fort Preble, Portland Harbor, Maine, in charge of Lieut. Col. C. E. Blunt, Corps of Engineers.—This work occupies such a position that three-fourths of its guns command the two principal channels entering the harbor of Portland.

The original work on this site was built in 1808. The new earthen batteries with parados and traverse magazines, which have been partially executed, are in an incomplete condition and suffering from exposure.

The condition of the work is unchanged from the close of the last fiscal year.

The derricks and other working machinery have so deteriorated during the long suspension that considerable expense must be incurred in their renewal.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year $35,000 00

Fort Scammel, Portland Harbor, Maine, in charge of Lieut. Col. C. E. Blunt, Corps of Engineers.—This work, commenced in 1841, occupies a very important position in the harbor, and commands four of the channels leading into it. It is an inclosed work with detached masonry bastions and heavy earthen batteries.

Plans for its modification and for additional earthen batteries have been prepared by the Board of Engineers for Fortifications and approved by the Secretary of War. They are only partially executed, and the work is in an incomplete condition.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year $100,000 00

Battery on Portland Head, Portland Harbor, Maine, in charge of Lieut. Col. C. E. Blunt, Corps of Engineers.—This modern earthwork, commenced in 1873, will, when completed, cover by its guns all the approaches to the main channel leading into the harbor, and will prevent by its fire an enemy's fleet from taking up, unopposed, a position behind Bang's Island from which to bombard Portland or shell the shipping in the harbor.

This work remains in the incomplete condition reported at the close of the last fiscal year.

For the construction of the operating-room and gallery for torpedo-cables and for continuing work on the battery itself, an appropriation of $50,000 is asked.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$50,000 00

Batteries on Cow Island, approaches to the harbor of Portland, Maine.—The object of these earthworks is, with batteries designed to be placed on Great Hog Island, to prevent an enemy's occupation of Casco Bay and to guard the passage from it to Portland Harbor.

Plans for the construction of batteries for the heaviest guns on this island have been prepared by the Board of Engineers for Fortifications, and it is proposed to commence work upon them as soon as funds are available.

No appropriation for their construction has yet been made.

Appropriation asked for next fiscal year	$50,000 00

Batteries on Great Hog Island, approaches to the harbor of Portland, Maine.—The object of these earthworks is, with batteries designed to be placed on Cow Island, to prevent an enemy's occupation of Casco Bay and to guard the passages from it to Portland Harbor.

Plans for the construction of batteries for the heaviest guns on this island have been prepared by the Board of Engineers for Fortifications, and it is proposed to commence work upon them as soon as funds are available.

No appropriation for their construction has yet been made.

Appropriation asked for next fiscal year	$50,000 00

DEFENSES OF PORTSMOUTH AND THE NAVY-YARD AT KITTERY.

Fort McClary, Portsmouth Harbor, New Hampshire, in charge of Lieut. Col. C. E. Blunt, Corps of Engineers.—This work, together with Fort Constitution, opposite, forms the inner line of defense to the mouth of the Piscataqua River and to the navy-yard at Kittery, Me.

The original fort was commenced early in the present century. An inclosed barbette work was commenced in 1863, but has not been completed.

The work remains the same as at the date of last report, no operations having been carried on except for the necessary care and preservation of the property.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

Fort Constitution, Portsmouth Harbor, New Hampshire, in charge of Lieut. Col. C. E. Blunt, Corps of Engineers.—This work, together with Fort McClary, opposite, forms the inner line of defense to the mouth of the Piscataqua River and to the navy-yard at Kittery, Me.

Extensive modifications are required for the casemated work at this place before proceeding with its construction. Plans for an exterior earthen battery for heavy rifled guns have been approved by the Secretary of War, but it has not yet been commenced.

The condition of this work has remained unchanged since the date of the last Annual Report, no operations having been carried on except for the necessary care and preservation of the property.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

DEFENSES OF PORTSMOUTH AND THE NAVY-YARD AT KITTERY—Continued.

Battery on Gerrish's Island, Portsmouth Harbor, New Hampshire, in charge of Lieut. Col. C. E. Blunt, Corps of Engineers.—This earthwork, with the one opposite on Jerry's Point, forms the outer line of defense to Portsmouth Harbor and to the navy-yard at Kittery, Me. It was commenced in 1873.

The work remains in the same incomplete condition reported at the close of the last fiscal year.

Plans for the completion of this work have been prepared by the Board of Engineers for Fortifications and approved by the Secretary of War, but are only partially executed.

An appropriation is asked for constructing the operating room and gallery for torpedo cables and continuing work on the battery proper.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$36,000 00

Battery on Jerry's Point, Portsmouth Harbor, New Hampshire, in charge of Lieut. Col. C. E. Blunt, Corps of Engineers.—This earthwork is on the western side of the entrance to the harbor of Portsmouth, New Hampshire, and with the battery at Gerrish's Island on the opposite side of the entrance, forms the outer line of defense to that harbor and to the navy-yard at Kittery, Me. It was commenced in 1873.

Plans for the completion of this work have been prepared by the Board of Engineers for Fortifications and approved by the Secretary of War, but are only partially executed.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$50,000 00

DEFENSES OF BOSTON AND THE NAVY-YARD AT CHARLESTOWN.

Fort Warren, Boston Harbor, Massachusetts, in charge of Col. Henry W. Benham, Corps of Engineers.—This important casemated work on George's Island, commenced in 1833, is for the defense of the main channel of entrance to Boston Harbor, and commands the anchorage of Nantasket Roads.

From want of funds operations have been confined to a general care and oversight of the property stored at this post, with such minor repairs as the allotment from the general appropriation for the preservation and repair of fortifications would permit. These repairs consisted of a replastering of the concrete roof of the new magazine in the parade of bastion B, and the relaying of part of the brick wall closing its inner end. Repairs were also made to the earth slopes of the ravelin, and to all of the main surface drains. The new exposed iron-work, such as pintles, traverse circles, &c., has been scraped and painted, and some needed temporary repairs have been made to the engineer buildings.

The condition of the work at the close of the fiscal year is essentially the same as at the date of my last report. The defects in the scarp of front II., and the injuries to the unfinished concrete masonry of bastion E, still continue, and will probably increase; but an attempt at temporary repairs is judged to be injudicious at this time.

DEFENSES OF BOSTON AND THE NAVY-YARD AT CHARLESTOWN—Continued.

An appropriation is asked for the modification and completion of the work according to plans prepared by the Board of Engineers for Fortifications.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$100,000 00

Battery at Long Island Head, Boston Harbor, Massachusetts, in charge of Col. Henry W. Benham, Corps of Engineers.—This earthwork occupies an important position in the outer line of defense for Boston Harbor, and its guns bear on all the channels of entrance.

It was commenced in 1871, and was designed for the reception of the heaviest modern ordnance. Nothing has been done in construction since the fiscal year 1875–'6 for want of appropriations, and the work, the plans of which have been prepared by the Board of Engineers for Fortifications and approved by the Secretary of War, is in an unfinished condition.

Owing to the want of an appropriation, no active operations have been under way; but some small repairs have been made to the engineer buildings, and the new iron 15-inch gun carriages and chassis have been scraped and painted, as have also the pintles and traverse circles of the gun platforms.

The condition of the work at the close of the year is essentially the same as at the date of my last report. Certain minor repairs to the masonry, &c., are needed, which could be made advantageously during the present fiscal year.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$50,000 00

Fort Winthrop, Boston Harbor, Massachusetts, in charge of Col. Henry W. Benham, Corps of Engineers.—This work, on Governor's Island, is one of the works forming the inner line of defense for Boston Harbor.

The present work was commenced in 1844, and consists of a central casemated keep and exterior earthen batteries.

With the exception of slight repairs to the earth slopes, drains, and buildings, and the repainting of all the exposed iron work of the new gun platforms, no operations have been undertaken during the year, owing to the want of funds.

The work remains in essentially the same condition as at the date of my last report, and will be in as good order as when active operations were suspended in 1876, if certain small repairs, intended to be made during the present fiscal year, have been completed. The mortar battery is intended for six or twelve mortars. All of the gun platforms of this fort, with the exception of the eleven in the exterior tower battery, are now ready for their armament.

The necessities for the sea-walls, heretofore recommended for the protection of the east bluff of this island and on the south of the main work, are more and more apparent every year. They are estimated to cost $30,000 and $25,000, respectively.

DEFENSES OF BOSTON AND THE NAVY-YARD AT CHARLESTOWN—Continued.

The plans of this fort have been modified by the Board of Engineers for Fortifications for the reception of modern ordnance, and they have been partially executed, but no work has been done since the fiscal year 1875–'76 for want of appropriations.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$50,000 00

Fort Independence, Boston Harbor, Massachusetts, in charge of Col. Henry W. Benham, Corps of Engineers.—This casemated work, situated on Castle Island, is one of the inner line of defenses for the harbor of Boston.

The present work was commenced in 1833.

Active operations have again been suspended during the entire year from want of a specific appropriation. Small repairs to the slopes, drains, and buildings were made from time to time when necessary, and the iron-work of the new 15-inch gun platforms was scraped and painted.

The work remains in about the same condition as at the date of the last report, and with some contemplated repairs to the slopes and exposed masonry would be fully in as good order as at the close of active operations in 1876, with the exception of one gun platform in the east exterior battery, on a made embankment, which has settled so as to require resetting.

The plans of this work have been modified by the Board of Engineers for Fortifications for the reception of modern heavy ordnance, and they have been partially executed, but no work has been done since the fiscal year 1875'–76, on account of want of appropriations.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$50,000 00

DEFENSES OF NEW BEDFORD.

Fort at Clark's Point, New Bedford Harbor, Massachusetts, in charge of Lieut. Col. G. K. Warren, Corps of Engineers.—This casemated work, commenced in 1857, commands the entrance of the harbor of New Bedford.

Plans for new earthen batteries for modern heavy guns have been completed by the Board of Engineers for Fortifications, and work can be begun as soon as money is appropriated.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$30,000 00

DEFENSES OF NARRAGANSETT BAY.

Fort Adams, Newport Harbor, Rhode Island, in charge of Lieut. Col. G. K. Warren, Corps of Engineers.—This large and important work,

DEFENSES OF NARRAGANSETT BAY—Continued.

commenced in 1824, defends the harbor and city of Newport, and commands the principal passage to Narragansett Bay, one of the best roadsteads on the coast.

The preparatory work for the construction of the new exterior earthen battery for modern ordnance (such as opening roads, draining the grounds, &c.) having been all completed, rapid progress can be made in construction when the necessary funds are appropriated. This important battery at the end of the fiscal year 1875–'76 had but recently been commenced, in accordance with plans approved by the Secretary of War, and no work has been done since that year for want of appropriations. Many repairs are needed to the main work and to the permanent wharf.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.	
Appropriation asked for next fiscal year	$30,000 00

Defenses of Dutch Island, western entrance to Narragansett Bay, Rhode Island, in charge of Lieut. Col. G. K. Warren, Corps of Engineers.—These earthworks, commenced in 1863, command the western passages to Narragansett Bay.

The appropriation asked is for continuing the construction of barbette earthen batteries for modern ordnance, in accordance with plans approved by the Secretary of War.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.	
Appropriation asked for next fiscal year	$40,000 00

DEFENSES OF NEW LONDON HARBOR AND NAVY-YARD.

Fort Trumbull, New London Harbor, Connecticut, in charge of Maj. J. W. Barlow, Corps of Engineers.—This fort, commenced in 1838, is situated upon the west bank of the Thames River, about two miles above its mouth, and commands the channel entrance and crosses its fire with that of battery Griswold, upon the opposite bank.

It is a casemated work, built of granite, with brick arches, and there are two exterior batteries, one at the southwest of the fort and one at the northeast—a new battery.

The fort was probably originally sufficient for the objects in view, but is now inadequate to protect the city of New London from capture, and the occupancy of the harbor by a hostile fleet. It is situated upon an interior line, which, though important, should not be solely relied upon. This line should be auxiliary to an exterior one established at the mouth of the river, two miles below, where excellent sites for works suitable for a thorough protection of the harbor ought to be secured without delay.

The importance of this harbor in case of a foreign war cannot be overestimated. It is readily accessible to all classes of vessels, and its possession by an enemy would secure to him the control of Long Island Sound and the cities upon its borders. In the present state of its defenses the capture of the harbor would be an easy matter, and its recovery attended with enormous cost.

DEFENSES OF NEW LONDON HARBOR AND NAVY-YARD—Continued.

With a small sum allotted from the general appropriation for preservation and repair of fortifications, the twelve recess and embrasure arches, which were of brick and much deteriorated, have been taken out and replaced by *béton aggloméré*. The parapet of the main work and place of arms has been repaired by adding to the breast-high wall a course of 6 by 6 inches granite, the interior slope of earth being connected at the back of this course, so as to give sufficient soil for the support of the grass. The roads have been improved by the addition of oyster-shells, and the gutters relaid where necessary. The portcullis has been put in working order without the necessity of removing the shafts. The machinery can now be kept in good condition by ordinary attention on the part of the garrison.

The recommendation of last year is renewed, that an appropriation of $40,000 be made for the next fiscal year, to be applied to building the south exterior battery in accordance with approved plans.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$40,000 00

Fort Griswold, New London Harbor, Connecticut, in charge of Maj. J. W. Barlow, Corps of Engineers.—This barbette earthen work, commenced in 1840, is auxiliary to Fort Trumbull in the defense of New London Harbor. It occupies an important site upon the east bank of the Thames River, nearly opposite the city of New London. Its guns command the channel from below the mouth of the river to Winthrop's Point, above New London, and, with the batteries of Fort Trumbull, give a cross-fire upon the entire harbor. Plans for the modification of this earthwork, to enable it to mount the heaviest modern guns, were prepared by the Board of Engineers for Fortifications and approved by the Secretary of War in 1874, but for want of appropriations the work of construction has not commenced.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$25,000 00

DEFENSES OF NEW HAVEN.

Fort Hale, New Haven Harbor, Connecticut, in charge of Maj J. W. Barlow, Corps of Engineers.—This work, on the east side of the harbor, commands the channel of entrance and is the only defense of the city of New Haven against a naval attack.

The fort is a temporary structure, built about the close of the late war, and is much deteriorated. The site is an important one, and should be occupied by a permanent fort. Fortifications exterior to this should also be built near the old light-house, to prevent the anchoring of an enemy's fleet at the mouth of the harbor, whence he would be able to bombard the city. The wealth and commercial importance of New Haven would seem to warrant a marked improvement in the character of its defenses, involving a system of permanent works adequate to its thorough protection in case of a foreign war.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

DEFENSES OF NEW YORK AND THE NAVY-YARD AT BROOKLYN.

Fort Schuyler, East River, New York, in charge of Lieut. Col. H. L. Abbot, Corps of Engineers.—This is an important work for the defense of the entrance to the harbor of New York City through the East River. It was commenced in 1833.

Owing to the want of funds, nothing more than the ordinary care of the property has been possible during the past year.

The condition of the several batteries, &c., remains the same as stated in the annual report of last year, since which time no change has occurred, except the gradual deterioration consequent upon exposing unfinished work to the action of the weather. The completion of the barbette tier of the main work is greatly to be desired to check this progress and to put the fort into a condition to receive its new armament promptly in case of war. The completion of the parados of the 10-gun earthen battery—a work requiring time—for a like reason should not be delayed.

The necessity of immediately resuming work at this place is sufficiently set forth in the remarks upon the fort on Willets Point, which co-operates with Fort Schuyler in the defense of the East River entrance of New York Harbor.

The sum asked ($150,000) is urgently needed to complete the extension of the barbette tier of the main work and other modifications designed to give room for a modern armament; to repair the sea-wall, and to continue the parados of the 10-gun earthen battery as far as the funds will permit.

Time is essential to this work, and if left until the breaking out of war the position could not be properly defended.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$150,000 00

Fort at Willets Point, eastern entrance to New York Harbor, in charge of Lieut. Col. H. L. Abbot, Corps of Engineers.—This fort, which was commenced in 1863, is designed, together with Fort Schuyler, to close the harbor of New York City against approach from Long Island Sound. In former years the natural obstructions at Hell Gate, the location of the navy-yard and of the great commercial interests near the southern end of Manhattan Island, and the limited range of artillery, all combined to make this channel of much less importance to the defense than that through the Narrows; and the armament and emplacements were accordingly planned on a smaller scale. The modern increase in range and power of artillery, the growth of the city toward the north, and the improvements at the Hell Gate channel, have thus done relatively more to uncover New York City on this side than on the other; and prompt attention is now demanded to prepare for even a respectable defense against any fleet likely to be used in attacking the city.

In the present state of the defenses the torpedo lines could not be properly protected, nor could the works needful for the purpose be constructed in haste. The site is contracted, and the concrete needful for gun platforms cannot be subjected to heavy shocks when newly laid. It requires time to harden, and it cannot be laid in freezing weather. Time is absolutely essential to proper preparation. It will be a fatal mistake to suppose either that the work can be done promptly at the beginning of a war or that the channel can be effectively closed by torpedoes in the present state of the forts.

DEFENSES OF NEW YORK AND THE NAVY-YARD AT BROOKLYN—Continued.

Fortunately, much work has already been done upon the new earthworks planned since the war, and a moderate sum would add greatly to their present value. The principal part of the grading and sodding is done, and all but three of the traverse magazines are serviceable.

The stone fort, being in an unfinished condition, is gradually deteriorating from the exposure to the weather; and it is very desirable that the second tier arches should be turned and asphalted to protect the casemates, which, in an emergency, would be of much value to the defense. This is doubly important since the armament has been placed in position and requires to be kept covered with paulins, on account of the leakage upon them.

Nothing but the simple care of the works has been possible during the past year. The funds have been only sufficient for absolutely necessary repairs, which have included the extensive earthen slopes, the sea-wall, the engineer wharf, temporary buildings, tools and implements, and the steam engine and boilers.

An appropriation is desired to complete the parapet of the middle (earthen) battery, to construct three service magazines, and to prepare platforms for twenty guns.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$80,000 00

Defenses of Governor's Island, New York Harbor, in charge of Col. Henry W. Benham, Corps of Engineers.—These works are Fort Columbus, Castle Williams, South Battery, and New Barbette Battery. They, with Fort Wood, on the opposite side of the channel, defend the entrances to the East River and the Hudson River. The fortifications on Governor's Island were commenced in 1831.

The exterior heavy earthen batteries are as yet unfinished, and a new sea-wall on the shore, in rear of the officers' quarters, is very greatly needed.

During the last fiscal year the scarp-wall of Castle Williams has been color-washed by the garrison with the material furnished by the Engineer Department in December, 1879; and the asphalted felting with which the terreplein of this castle was covered in the latter part of the same year has, no doubt, answered the purpose intended, as no complaints about leakages there have reached me thus far.

In the annual report for the year 1877, estimates were made for an extension of the sea-wall on the west side of the island, and for surface-drains in the moat of Fort Columbus. The recommendations then made are repeated. The shore-line along the southeast part of the island, back of the range of officers' quarters, between the South Battery and the main wharves, is without protection, and is irregularly broken down by the wash of the waves in storms, while in front, or outward from the shore, a shoal extends, bare at low-water, to the distance of 100 feet to 200 feet, which, from its position in the eddy between the Buttermilk Channel and the Hudson River, receives the drift and carrion offal of the river, making it very offensive and injurious to the health of the garrison on the island.

The best remedy for this, and a necessity, is considered to be a sea-

DEFENSES OF NEW YORK AND THE NAVY-YARD AT BROOKLYN—Continued.

wall of rounded or convex line of short faces, running out upon this shoal, which, without indentations, would give a regular current and direction to the water, thus tending to carry off all such offensive and deleterious matter, while the space in rear, filled up, as it might be without great cost, in part perhaps by the garrison, would add some acres to the area of the island, where every yard of land is so valuable. The construction of this wall is strongly urged by Gen. W. S. Hancock, commanding Military Division of the Atlantic; the Engineer officer in charge of the construction and repairs of the defenses, and by the medical authorities of the island.

The length of wall required would be about 1,800 running feet, and, if of 8 feet height, with stone facing and concrete backing and foundation, would cost, as near as can be estimated, about $20 per running foot, or $36,000. Adding for the wall on the west shore, the cost will be about $40,000.

The appropriation asked is for the foreging objects, and for continuing the construction of the exterior earthen battery for heavy ordnance designed by the Board of Engineers for Fortifications for this important site, and approved by the Secretary of War.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$75,000 00

(See Appendix No. 1.)

Fort Wood, Bedloe's Island, New York Harbor, in charge of Col. Henry W. Benham, Corps of Engineers.—This work, commenced in 1841, forms one of the inner line of defenses for New York Harbor, and with those on Governor's Island is designed to close the entrances to the East River and the Hudson River, and to protect New York, part of Brooklyn, and Jersey City from bombardment.

No operations have been under way during the year. A heavy modern earthern battery designed by the Board of Engineers for Fortifications is partially built, and its completion would finish all that is planned for this island.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$40,000 00

Fort Hamilton and additional batteries, New York Harbor, in charge of Col. Henry W. Benham, Corps of Engineers.—These works, commenced in 1824, are situated at the Narrows of New York Harbor, upon the Long Island side.

No regular appropriation having been made, the operations have been confined to such repairs as the limited allotment for this fort from the general appropriation for the preservation and repair of fortifications would allow. The larger part of the work performed was done with the view of stopping the leakages to the casemates of the fort proper, to insure drier and more healthy quarters for the garrison.

The terreplein of the channel or west front, which leaked to a great

DEFENSES OF NEW YORK AND THE NAVY-YARD AT BROOKLYN—Continued.

extent, caused by the separation of the parade wall from the arches, and the, in many places, broken brick pavement, has been supplied, after the mending of the latter, with a water-proof cover of asphalted felting and gravel, a method of repair which, considering its cheapness, seems to work very well, and which may answer the purpose for years if properly taken care of.

On the north front efforts have been made to stop the leakages in the arches over casemates 2, 3, and 4, as also around the bases of all those scarp-wall chimneys of the fort which had not already been repaired during the preceding fiscal year. Eight of these chimneys were entirely rebuilt.

On the exterior slope of the 15-inch gun battery a slide of about 120 feet in extent, and the fence on the foot of the same, have been repaired, as also part of the slope of entrance-way leading to the northern magazine in the rear of this battery.

For some necessary repairs and the completion of earthen batteries now in part constructed, in accordance with plans designed by the Board of Engineers for Fortifications, and approved by the Secretary of War, an appropriation for the next fiscal year is recommended.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$50,000 00

Mortar Battery at Fort Hamilton, New York Harbor, in charge of Col. Henry W. Benham, Corps of Engineers.—No operations were carried on during the past fiscal year.

Some little work yet remains to be done on this battery (which was commenced in 1871) to place it in a condition to receive its full armament, as projected by the Board of Engineers for Fortifications. The cost to finish this battery, amounting to about $1,100, is included in the estimate for Fort Hamilton and additional batteries.

No separate appropriation is asked for this work.

Fort Lafayette, New York Harbor.—This old work, commenced in 1812, and situated on a shoal at the Narrows entrance, occupies the best of all the positions for the defense of New York Harbor. It was injured by fire in December, 1868, to such a degree as to make it practically worthless, unless repaired at a very considerable outlay; and as it was adapted to guns of small caliber only, it was not thought worth while to restore it, but to replace it by a construction which should meet the demands of modern armaments.

The defense of New York Harbor requires a new work on this shoal which will admit of the mounting of 80 to 100 ton guns. It will require several years in building, and should be undertaken without delay.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$200,000 00

Fort Wadsworth, Staten Island, New York Harbor, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This fort, commenced in 1847,

DEFENSES OF NEW YORK AND THE NAVY-YARD AT BROOKLYN—Continued.

is situated on the west side of the Narrows, and constitutes a part of the second line of defense of the southern water approach to New York.

It is an inclosed work, built of granite, containing three tiers of guns in casemates, and one *en barbette*, the lower tier being only a few feet above the water-level.

The work, in connection with those adjacent to it on either side, Fort Tompkins and the two Glacis Batteries on the hill in rear, is designed to throw a heavy concentrated fire on vessels approaching or attempting to pass through the Narrows, crossing its fire with that from Fort Hamilton and batteries on the opposite side of the channel.

During the past year the 10-inch smooth-bore guns in the first tier were replaced by 8-inch rifles.

An appropriation of $9,000 is asked for next fiscal year, to be expended in clearing the ditch of the sand washed in from the slope of the hill in rear, in painting the iron-work in the embrasures, in pointing the masonry of the whole work, in replacing 25 old pintles in the barbette gun-platform with new 4-inch pintles, and in covering with a brick arch the reservoir which supplies the fort with water.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year the same reason.

Appropriation asked for next fiscal year	$9,000 00

Fort on site of Fort Tompkins, New York Harbor, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This work, commenced in 1858, with the earthen Glacis Gun Battery on its left, and the Glacis Mortar Battery on its right, crowns the hill in rear of Fort Wadsworth and the earthen batteries known as North Cliff Battery, South Cliff Battery, Battery Hudson, and the South Mortar Battery.

It is an inclosed pentagonal work, having on its four land faces two tiers of casemate quarters, a deep, dry ditch, and a heavy battery to resist a land attack, and on its channel front seventeen large casemates for storage and other purposes. It mounts its channel-bearing guns *en barbette.* It is intended to supply quarters for the garrison and act as a keep for all the defensive works occupying this position. Properly armed, this work will be able to throw a heavy fire from a commanding position upon vessels attempting to pass through the Narrows.

The four land faces were, for all defensive purposes, finished in 1865. In December, 1869, a plan giving such increased depth to the casemates that heavy rifled guns could be mounted over them *en barbette* was adopted and carried into execution.

Since 1876 the work has been in readiness to receive, on temporary platforms, all the heavy guns intended for channel defense. With funds supplied in part from other sources, the floors of three large casemates on the channel front were raised to the proper height, and the casemates in other respects were prepared for the storage of torpedo cases.

The estimates for the completion of Fort Tompkins comprise 10 permanent gun-platforms in place of the present wooden ones, 4 bonnets on the traverses for the better protection of guns and gunners, and finishing off 26 casemates for quarters, and 11 large casemates on the channel front for storage purposes. The appropriations for the Glacis Battery

DEFENSES OF NEW YORK AND THE NAVY-YARD AT BROOKLYN—Continued.

and the North Cliff and South Cliff Batteries are included in that for Fort Tompkins.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year.. $75,000 00

Glacis Gun Battery (north of fort on site of Fort Tompkins), Staten Island, New York Harbor, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This earthen barbette battery, built in 1872, is designed to supplement the barbette fire of Fort Tompkins. It has been in readiness to receive its armament on temporary platforms for the last six years, and may be reported as finished, although some little work remains to be done to the magazine doors and lamp closets. It is provided with timber gun-platforms and ample magazine room.

The cost of substituting stone for the timber gun platforms, and raising them breast high, in all amounting to $8,250, is included in the estimate for fort on site of Fort Tompkins. No separate appropriation asked for this work.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Glacis Mortar Battery (south of fort on site of Fort Tompkins), Staten Island, New York Harbor, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This battery, built in 1872 and 1873, is intended to throw a powerful vertical fire upon vessels approaching or attempting to pass through the Narrows. It is provided with ample storage and service magazine room, and is ready for service, although a little work yet remains to be done to the magazine lamp closets, and the principal magazine requires to be lined with wood.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year in the estimates under the general head of sea-coast mortar batteries.

Battery Hudson, Staten Island, New York Harbor, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This work, built in 1841 to 1843, and the North Cliff and South Cliff Batteries occupy the slope of the hill between the fort on site of Fort Tompkins and the water, and are able to bring a powerful direct fire upon the channel leading up to and through the Narrows.

For want of funds no work except that of preservation and repair has been done since the close of the fiscal year ending June 30, 1876. One of the new platforms was constructed for King's depressing carriage and a 15-inch smooth-bore gun mounted thereon.

The work necessary for the completion of this battery comprises 12 new permanent gun-platforms in place of old ones, the construction of a new breast-height wall in front of some of the platforms, and raising the wall to a higher level in front of others, the construction of bon-

DEFENSES OF NEW YORK AND THE NAVY-YARD AT BROOKLYN—Continued.

nets on the traverses, and the placing of a wooden lining in one of the principal magazines.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$20,000 00

South Mortar Battery (in rear of Battery Hudson Extension), Staten Island, New York Harbor, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This battery, commenced in 1872, is situated south of Fort Tompkins and directly in rear of Battery Hudson Extension. It is designed to throw a heavy vertical fire upon vessels approaching the Narrows from the lower bay. Since 1873 no appropriation has been made for it. The work necessary for its completion consists in constructing and laying eight timber mortar platforms, and in fitting up the inner magazines with doors and lamp closets. Estimated cost of completing the work, $9,000.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year in the estimates under the general head of sea-coast mortar batteries.

North Cliff Battery, Staten Island, New York Harbor, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This earthen gun battery, which was commenced in 1862, is located north of Fort Wadsworth, on the slope of the hill between Fort Tompkins and the water. It is designed to throw a direct fire upon vessels attempting to pass through the Narrows. It was intended for an armament of 15-inch smooth-bore guns or corresponding rifles, and was provided with two storage magazines, one large bomb-proof shelter, and five traverses between guns, two of them containing service magazines. Under a modification approved December 8, 1869, the bomb-proof shelter was suppressed and some traverses and service magazines between the guns were added, the number of guns being necessarily reduced thereby.

The 15-inch gun which occupied platform No. 1 was dismounted and sent away.

The cost of finishing this battery, by substituting six stone gun-platforms for those of timber, constructing six breast-height walls, two bonnets on the traverses, lining the two principal magazines with wood, thickening the parapet, and constructing a rough sea-wall at the foot of the exterior slope, amounting in the aggregate to $35,000, is included in the estimate for fort on site of Fort Tompkins.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

South Cliff Battery, Staten Island, New York Harbor, in charge of Lieut. Col. Q. A Gillmore, Corps of Engineers.—This earthen gun battery, occupying the slope of the hill between Fort Tompkins and the water directly south of Fort Wadsworth, was built in 1858 to 1861 for 15-inch guns or corresponding rifles, and was provided with two storage and two service magazines. In December, 1869, modifications were ordered, adding four new traverses, including two traverse magazines, by which the number of guns was necessarily reduced.

All the gun-platforms required by the new plan are in serviceable condition, although only two of them are supplied with a 6-inch pintle. All the other pintles are 5 inches in diameter. Much work remains to be done on the magazines and traverses.

The cost of finishing the battery, comprising the completion of four traverses, the construction of one new traverse magazine, adding to the thickness of the parapet, building a rough sea-wall at the foot of the exterior slope, lining the two principal magazines, and putting in new 6-inch pintles, amounting in the aggregate to $37,000, is included in the estimate for fort on site of Fort Tompkins.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Fort at Sandy Hook, New Jersey, in charge of Col. Henry W. Benham, Corps of Engineers.—This casemated work, commenced in 1857, commands the southern approaches by sea to the harbor and city of New York, and is also designed to prevent the occupation of the Lower New York Bay as an anchorage by an enemy's fleet.

No operations have been carried on for several years past, and the work remains in essentially the same condition as at the date of last annual report.

Owing to the want of a regular appropriation for this work, there have been no active operations during the past fiscal year. The sums allotted from the amount appropriated for the general preservation and repair of fortifications have been expended in the care and oversight of the military reservation and the public property stored here, with such repairs to storehouses and other engineer buildings as were found to be necessary for their safety and preservation; a small amount being also used in the repairing of the broken ends, and the refilling of that part of the sand-box bulkhead still remaining in position.

The condition of the fort itself is essentially the same as for several years past; and as to the works of protection to the shore east of the fort, I would state that about 500 feet of the sand-box bulkhead, constructed in the earlier part of the year 1878, still remains standing in a comparatively good condition, commencing opposite the southeast bastion at a point 150 feet south of the shoulder angle, and running thence southeast to within 100 feet of the canal-boat jetty No. 1; the land end of which latter being about 550 feet east from the salient of the southeast bastion. The concrete jetties built on this shore in former years are, with the exception of the canal-boat jetty mentioned, so much reduced by the incessant wash of the sea as to render them practically useless; and nothing now remains of the two brush jetties Nos. 3 and 8, to the north of the concrete jetties.

But still the changes on this beach do not indicate any great variations from a certain approximately stable bank, or high-water line, as the surveys for many years past seem to show, the sand washed away

DEFENSES OF NEW YORK AND THE NAVY-YARD AT BROOKLYN—Continued.

at one time being generally replaced at another in early succeeding storms.

This work is the most advanced of all the defenses of the southern approaches by sea to the harbor and city of New York. The channel of entrance opposite the Hook is more than a mile wide, and of depth sufficient for the largest and most powerful armored vessels yet built or designed. The occupation by an enemy's fleet of the capacious bay just within the Hook would prevent all egress from the harbor southward to the sea, and effectually seal up the main outlet from the city. The modification and completion of this important work for the reception of the heaviest modern rifled guns, protected by impenetrable iron armor, and the protection of the site against encroachments by the sea, are of very great importance, and an appropriation therefor is urgently recommended.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	**$150,000 00**

DEFENSES OF PHILADELPHIA, AND LEAGUE ISLAND NAVY-YARD.

Fort Mifflin, Delaware River, Pennsylvania, in charge of Col. J. N. Macomb, Corps of Engineers.—This fort, built in 1779, is situated on the right bank of the Delaware River, below its confluence with the Schuylkill. It guards the approaches to the port of Philadelphia and the League Island navy-yard, and is the only work of the projected line of interior works for the defense of the Delaware yet built or commenced.

The site of the fort is diked to protect it from overflow at high-water The Back Channel was formerly navigable for vessels drawing 16 feet, and was occupied by British war-vessels in the capture of Fort Mifflin in 1777, but is now a drain only. The main ship-channel, with a practicable low-water depth of 29 feet, passes within 700 yards of the fort, and the improvement of the Delaware navigation now in progress permits the passage of ships drawing 27 feet.

In its present condition it is incapable of effective operations against modern ordnance and ships of war. It will be necessary to make extensive alterations in the main work, and to supplement these with heavy earthen batteries above and below.

Under the approved plans of the Board of Engineers for Fortifications, the preparation of exterior earthen works to receive heavy guns was commenced, but since 1875 no appropriations have been made, and the work is in the incomplete condition which was reported last year.

Operations during the last fiscal year have been confined to the general care and preservation of the work, viz, cleaning the moat; making needed repairs at interior end of main sluice; to breast-height wall in main works and demilune, and constructing temporary covering of lumber to 12 gun-platforms.

Should appropriations be made for 1882-'83, the plans already prepared would be pursued in the following work:

Constructing torpedo casemate-gallery; completing exterior earthen battery; constructing earthen battery on north face of demilune; constructing an earthen battery on south face, with two traverses; commencing storage magazine for exterior earthen battery.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.
Appropriation asked for next fiscal year $90,000 00

Mortar Battery at Fort Mifflin, Pennsylvania, in charge of Col. J. N. Macomb, Corps of Engineers.—The site of this battery is on the reclaimed land west of the main work and north of the unfinished gun-battery. Operations for its construction commenced in 1871 and continued till near the close of the fiscal year ending June 30, 1874, since which time work has remained suspended for want of funds.

This battery, the plans of which were prepared by the Board of Engineers for Fortifications, remains in an unfinished condition, and is suffering from exposure.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.
Appropriation asked for next fiscal year in the estimates under the general head of sea-coast mortar-batteries.

Site for defenses at Red Bank, New Jersey, in charge of Col. J. N. Macomb, Corps of Engineers.—This site, covering about 100 acres on the New Jersey bank of the Delaware, nearly opposite Fort Mifflin, was purchased in 1872 with the intention of constructing thereon an earthen barbette work, which, in conjunction with the works at Fort Mifflin, should constitute the inner line of defense for Delaware River. Red Bank was the site of a Revolutionary work named Fort Mercer, which successfully resisted an attack by 1,200 Hessians under Count Donop on the 21st of October, 1777.

No appropriation has been made for this work. The site is an important one, on a bluff commanding the channel at short range. Its occupation by a suitable armament is indispensable to any attempt to defend the port of Philadelphia.

The property remains in charge of a keeper, and some necessary repairs to the dike protecting the lower portion bordering Woodbury Creek were made during the last year.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

Fort Delaware, Delaware River, Delaware, in charge of Col. J. N. Macomb, Corps of Engineers.—Fort Delaware, on Pea Patch Island, about 42 miles below Philadelphia, constitutes, with the batteries on the New Jersey and Delaware shores, the outer line of defenses for the Delaware River. The main ship-channel passes to the eastward, its further 24-foot curve being within 1,000 yards of the fort.

The work of modifying this casemated fort (the masonry of which was commenced in 1852) to adapt it to the greater size and power of modern ordnance has remained suspended since 1876 for want of appropriations, and the fort and island are substantially as reported last year.

Pea Patch Island is only protected against the river by dikes which

DEFENSES OF PHILADELPHIA, AND LEAGUE ISLAND NAVY-YARD—Continued.

the storm of October, 1878, proved to be inadequate. They should be raised at least 2 feet and proportionably strengthened.

During the past year the wooden wharf on the eastern side of the island has been thoroughly repaired; the deposit of mud in the moat has been nearly cleaned out, and some repairs have been made to the temporary buildings and to the boats.

The breast-height wall of the barbette, the retaining walls of the magazine traverses, the parade walls, the barracks and officers' quarters, the southern wharf, and the temporary buildings outside the fort, all need extensive repairs. The stone wharf on the eastern side remains unfinished. To restore the healthfulness of the island, the cleaning of the moat and ditches should be completed, and the decaying material, scattered over its surface by the inundation of 1878, should be thoroughly cleared up. The dikes are in good condition, but their height is, as before stated, insufficient for full protection.

Fort Delaware was designed to be, and is, the main defense of the Delaware River, but it is not in a condition to cope with modern ships of war. Extensive modifications are imperatively necessary, and an appropriation therefor is urgently recommended.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.	
Appropriation asked for next fiscal year	$75,000 00

Battery at Finn's Point, Delaware River, New Jersey, in charge of Col. J. N. Macomb, Corps of Engineers.—This is designed to be a powerful earthen barbette battery, and forms the left of the outer line of defenses across the mouth of the Delaware River.

Its construction, in accordance with plans prepared by the Board of Engineers for Fortifications, and approved by the Secretary of War, was begun in 1872. It is only partially completed, no appropriation having been made for it since the appropriation for the fiscal year 1875–'76. From its unfinished condition, and the insufficient protection against the river furnished by the dikes and sea-wall, the work suffers yearly from deterioration. The storm of October 23, 1878, did great damage, as it raised the river level to 11 feet 5 inches above mean low-water.

The battery remains substantially as reported last year, with the exception that for want of a river wall, which cannot now be built for lack of funds, the washing away of the exposed exterior slope has continued.

During the past year the wharf has been repaired; slight repairs have been made to the dike; and a new road leading to the national cemetery has been fenced where it passes through a cultivated field.

The appropriation asked for the year 1882–'83 would be applied to repairing and raising the dikes and sea-wall, to constructing 4 gun-platforms with breast-height wall, 2 magazines, 3 traverses, and the passage through the battery from the wharf, and to continuing the embankment of the battery.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.	
Appropriation asked for next fiscal year	$50,000 00

DEFENSES OF PHILADELPHIA, AND LEAGUE ISLAND NAVY-YARD—Continued.

Mortar Battery at Finn's Point, Delaware River, New Jersey, in charge of Col. J. N. Macomb, Corps of Engineers.—This work forms a part of the earthen barbette battery at Finn's Point. It was commenced in 1872, according to plans prepared by the Board of Engineers for Fortifications, and in the two following years two magazines were built; a sea-wall at the foot of the exterior slope was constructed to a height of 9 feet above mean low-water; the terreplein was embanked and the traverses and parapet commenced. Since then no work has been done for want of funds. The sea-wall has been badly damaged by storms, and the unfinished embankments have been considerably washed away.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year in the estimates under the general head of sea-coast mortar-batteries.

Fort opposite Fort Delaware, Delaware shore, in charge of Col. J. N. Macomb, Corps of Engineers.—This is designed to be a strong earthen battery, forming the right of the lower line of defense for the Delaware River. The site was purchased in 1871, and the work was commenced in 1873.

No appropriation has been made since the appropriation for the fiscal year 1875–'76, and the work is in an incomplete condition.

For continuing its construction, in accordance with plans prepared by the Board of Engineers for Fortifications, and the protection of the site, an appropriation for the next fiscal year is recommended.

The only work done at this battery during the past year has been the repairing of the wharf. The head was raised 10 inches by putting on an additional cap, and the sides were brought to the same level; some decayed timbers were replaced by new; the stone retaining walls of the inner portion, or roadway, were relaid and built higher, and the whole wharf was filled in with mud from the flats alongside, as far as practicable, and the rest with earth. The derrick at the head of the wharf has been taken down and stored.

The appropriation asked for 1882–'83 would be expended in rebuilding dikes, repairing wharf, completing the torpedo cable gallery, constructing 7 additional gun-platforms with the necessary breast-height wall, 3 magazines and 3 traverses, and continuing the embankment of the battery.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$75,000 00

Mortar Battery opposite Fort Delaware, near Delaware City, Delaware, in charge of Col. J. N. Macomb, Corps of Engineers.—The construction of this battery was commenced in 1872, according to plans prepared by the Board of Engineers for Fortifications, and in the next year 2 magazines were nearly completed, the terreplein was formed, and the parapet embanked about 7 feet above that level. Nothing more was done until 1876, when a small balance of an old appropriation was applied to completing the two magazines and embanking the two traverses, with

DEFENSES OF PAILADELPHIA, AND LEAGUE ISLAND NAVY-YARD—Continued.

the parapet in front of them, to nearly their full height. The work is in an unfinished condition.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for the purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year in the estimates under the general head of sea-coast mortar-batteries.

DEFENSES OF BALTIMORE.

Fort McHenry, Baltimore Harbor, Maryland, in charge of Lieut. Col. William P. Craighill, Corps of Engineers.—This fort forms part of the inner line of defense for Baltimore and its dependent interests, and commands with its fire the interior waters of the harbor and the channel of approach thereto, in which latter a depth of 24 feet exists at mean low-water.

The fortifications at this place were commenced in 1775, and in 1794 the present work was built.

Although the original fort has become almost useless as a defensive work, the site is still an important one, and the water-front should be occupied by a battery of modern guns, mounted behind an earthen parapet of the most approved dimensions, and provided with bomb-proof cover for ammunition and gunners. Such a battery, the plans of which were prepared by the Board of Engineers for Fortifications, was commenced in 1872, and is partly constructed, although all work upon it has been suspended for want of funds since July, 1876.

A bulkhead of ballast having been made by the United States, without expense, along a line in front of the site, and at a distance from the authorized pier line of 375 feet, and a line having also been established in the rear of the site at the same distance from the pier line, it is proposed to fill in the whole area thus defined with ballast from ships coming to the port. The available limits of the site will thus be largely increased, without expense to the United States.

Considerable progress has been made in this filling with ballast in front of the site, and the contractor for dredging in the channel near the fort has dumped about 65,000 cubic yards of material on the flats behind the site during the year.

Some repairs have been made to the sea-wall, to the slope of the unfinished battery, and to drains. They are the following: 150 feet of brick gutter in the fort at the foot of the parade-wall taken up and relaid; 46 feet of new brick and stone gutter on the right flank of the new battery; 200 linear yards of coping of sea-wall removed and relaid, and underpinned to a greater or less extent; 22 linear yards of coping of sea-wall removed, relaid, and from 1 foot in height, to 1 foot 6 inches of wall rebuilt under it; 132 linear yards of coping on sea-wall underpinned; 59 linear feet of the sea-wall taken down and rebuilt (57 cubic yards); 144 cubic yards of embankment placed, to reduce the declivity of the interior slope of a portion of the new battery; and 207 square yards of sod revetment laid; 70.5 feet of coping were removed from the front, where the area is being filled in and used to replace coping broken or washed away of that portion repaired.

A sea-wall should be built along the line of the temporary bulkheads

DEFENSES OF BALTIMORE—Continued.

referred to above, and the present wharf should be removed and a new one built near the new dry-dock.

To continue work on the new earthen battery the sum of $50,000 is asked for the next fiscal year, which would nearly complete the parapet and terre-plein of the unfinished battery, including magazines, but not the gun-platforms.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$50,000 00

Fort Carroll, Baltimore Harbor, Maryland, in charge of Lieut. Col. William P. Craighill, Corps of Engineers.—This fortification, commenced in 1847, is situated upon an exterior line of defense for the harbor of Baltimore.

It is proposed to modify this important casemated work so as to enable it to receive the heaviest modern rifled guns, protected by iron armor of such form and thickness as to be impenetrable by any guns which may be brought to our coasts. Its completion is indispensable to the safety of the rich city of Baltimore in time of foreign war, and the work to be done cannot safely be left until the approach of hostilities. It will require several years and liberal appropriations to accomplish it, and it should be commenced without delay.

Operations during the past year have been confined to the general care and preservation of the work and the public property stored thereat. They have been of small extent, consisting mainly in repairs of roofs of sheds, houses, casemates, and magazines.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$100,000 00

DEFENSES OF WASHINGTON.

Fort Foote, Potomac River, Maryland, in charge of Lieut. Col. William P. Craighill, Corps of Engineers.—This earthwork, commenced in 1862, is on the inner line of defense of the channel of approach by water to Alexandria and the capital of the United States. The site is commanding and very favorable.

Projects for the modification of this fort and for an additional battery for the use of the heaviest modern guns have been prepared by the Board of Engineers for Fortfications. They were partially executed when work was suspended by reason of failure of appropriations, the last of which was for the fiscal year ending June 30, 1874. Attention is again urged to the fact that the fort in its present unfinished condition is daily becoming much deteriorated. The modification of the work should be resumed and completed as soon as possible.

During the past fiscal year but little could be done for want of funds.

For the more economical and satisfactory supervision of the property one small detached shed was taken down and another put up in a more convenient place, the new shed being built chiefly from the materials of the old, and the property in the old shed being removed to the new.

Several new box drains have been put in on the sides and under the roadway leading from the wharf to the plateau on which the fort stands. The drainage of the ditch of the fort has also been improved by putting in a box-drain down to the adjacent ravine, and thus preventing the washing and caving of the slope.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.	
Appropriation asked for next fiscal year	$50,000 00

Fort Washington, Potomac River, Maryland, in charge of Lieut. Col. William P. Craighill, Corps of Engineers.—This fort occupies a very important position on the outer line of defense of the cities of Alexandria, Washington, and Georgetown, and the interests connected with them.

The importance of this site has been fully set forth in previous annual reports. The casemated fort, commenced in 1816, is of very little value, and the new earthen batteries, which have been devised in accordance with the latest ideas of defensive arrangement, have been barely begun. There has been no specific appropriation for this place since that for the fiscal year 1873–'74. The unfinished work is constantly suffering deterioration.

Attention is again earnestly asked to the need of continuing and finishing the new batteries.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.	
Appropriation asked for next fiscal year	$50,000 00

Obstructions of the Potomac, in charge of Lieut. Col. William P. Craighill, Corps of Engineers.—The material pertaining to these obstructions has continued in store at Fort Foote, in charge of a watchman. The timber portion is very much decayed and is rapidly becoming worthless. The irons are in good condition.

DEFENSES OF HAMPTON ROADS AND GOSPORT NAVY-YARD.

Fort Monroe, Old Point Comfort, Virginia, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This extensive work, commenced in 1817, occupies an important position, covering, in co-operation with Fort Wool, on the opposite side of the channel, the only approach from the sea to Hampton Roads, the cities of Norfolk and Portsmouth, the Gosport navy-yard, and the James River.

These works, also, in offering a safe rendezvous for our own vessels of war, afford indirect protection to Baltimore, Annapolis, and Washington, and all the harbors and towns on the Chesapeake Bay and Potomac River. The work covers an area of 86 acres, and the distance around it is 1¾ miles.

The modifications that have been planned and approved for adapting Fort Monroe to the requirements of efficient defense against war vessels of recent type, contemplate arming the channel front of the advanced redoubt with heavy barbette guns, provided with suitable traverses and traverse magazines; mounting a similar armament in the re-entering place of arms, located on the right of the redoubt in advance of Front

No. 5; constructing a new open battery for barbette guns to the right of the old casemated water-battery; and placing a few heavy guns in the salients of the main work and covered way. There is plenty of room for mortar-batteries both within and without the work.

The work of making the requisite modifications has been suspended for several years past for want of appropriations.

In the advanced earthen redoubt the two traverse magazines are finished, except the earth covering to one of them, and six gun-platforms are nearly completed. Most of the earthwork of the redoubt is also finished. In the place of arms the concrete service magazine is finished, but not covered with earth, and the concrete foundations for the gun-platforms have been laid. The new 10-gun earthen battery has not been commenced.

The operations during the last fiscal year were confined to the repairs necessary for the protection and preservation of the work. Repairs were made to the exterior slope of the advance redoubt where the tide had overflowed the retaining wall, and cut into the earthwork of the parapet. A temporary 3-inch plank revetment was built in upward continuation of the retaining wall, and carried 2 feet above high-water mark for a length of 520 feet along the foot of the earth slope. The embankment was then filled in to its original height with sand, clay, and soil, and properly sodded. Some slight repairs were made to the parapet of covered way near the east end of the water-battery, and also to the ramps inside the main work. The bridge and railing over the sluice in advance of Front 5 were entirely rebuilt and painted. The dry ditch, 360 feet long, 3 feet wide, and 4 feet deep, which drains the road skirting the parade, was thoroughly cleaned, the rough stone and rubble replaced, and the ditch covered with a layer of gravel 4 inches thick.

New fencing for a total length of 1,825 feet was built to replace the old fences inclosing engineer shops, store-yard, quarters, stables, &c., The engineer headquarters, building and the office were painted outside and the engineer shops, stables, fences, quarters, &c., were white and yellow washed.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$75,000 00

Artesian Well at Fort Monroe, Virginia, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—No work was done during the last fiscal year and none is contemplated during the present fiscal year for want of funds. The inadequate and uncertain supply of water at Fort Monroe is an evil which, it is conceded on all sides, may at any time arise to serious magnitude. The present depth of the well is about 900 feet. It is recommended that provision be made to increase this depth to 1,200 or even 1,500 feet before abandoning the project of obtaining a water supply by this method.

No appropriation was made for the fiscal year ending June 30, 1882.

Appropriation asked for next fiscal year	$10,000 00

Fort Wool, Hampton Roads, Virginia, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This work unites with Fort Monroe in closing the sea approach to Hampton Roads, being located on the opposite side of the channel from that work, and therefore crossing its fire with it.

Fort Wool is an inclosed casemated fort. It was begun in 1818 by forming an artificial foundation with stone of random sizes, unloaded upon a 10-foot shoal selected as the site of the work. When the scarp wall and piers had reached a height to include the lintels of the lower tier of embrasures, settlement began, and work was stopped after piling a quantity of stone upon the walls, sufficient to bring upon the foundation a pressure somewhat exceeding that of the finished work.

The work of construction was resumed in 1858, and when it was suspended, 52 casemates of the lower tier, with iron-throated embrasures, were finished and ready for the guns. On the second tier, the scarp wall and piers of those portions of the work bearing on the channel had reached nearly to the height of the embrasure lintels, the embrasure irons had been set, and the floors of most of the casemates paved. On the gorge faces very little work had been done.

It is designed to modify this important work so that it may receive the heaviest modern rifled guns, protected by impenetrable iron armor. The work to be done, which will require several years for its execution, cannot be left until the near approach of war, and a liberal appropriation for it is urgently recommended.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year $150,000 00

DEFENSES OF BEAUFORT HARBOR, NORTH CAROLINA.

Fort Macon, Beaufort Harbor, North Carolina, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This barbette work, commenced in 1826, is situated at the mouth of the harbor on the south side, and defends the principal approach thereto from the sea.

More than twenty years ago five short spur jetties, formed of stone of random sizes, and extending a little beyond the low-water mark, were built to the east and south of the fort, for the security of the site. Until quite recently they thoroughly subserved their purpose. The two on the left or inner end of the line have settled so that their shore ends are at the low-water level. The next two have apparently remained intact, while the outer one (No. 5) has altogether disappeared from sight.

A storm which occurred in August, 1879, produced such extensive changes in the vicinity of the fort that recourse was had to a board sand-catch, with a view, if possible, of restoring the beach to its former area and height. The results have been satisfactory and the sand is gradually accumulating in several localities where most needed.

Under the apprehension that the security of this site will require the restoration or renewal of two, and perhaps three, of the spur jetties at an early day, an appropriation of $6,000 is asked for that purpose.

A project for adapting this work to the requirements of modern defense is under consideration.

No appropriation was made for the fiscal year ending June 30, 1882.

Appropriation asked for next fiscal year for protection of the site $6,000 00

DEFENSES OF WILMINGTON.

Fort Caswell, mouth of Cape Fear River, North Carolina, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This barbette work, commenced in 1826, covers the entrance into Cape Fear River, and hence the water approach to the city of Wilmington, and constitutes the only defense of that locality.

Upon its evacuation by the Confederate forces in January, 1865, immediately after the fall of Fort Fisher, an attempt was made to blow it up. All the scarp wall of the southeast face was overturned by a mine exploded in the scarp gallery of that face; a portion of the scarp wall of the north and west fronts was so badly shattered by the explosion of a magazine on the covered way near northwest salient that it will have to be rebuilt, and the citadel on the parade of the work was burned. There is now neither armament nor quarters for a garrison at the place.

The subject of its modification is now under consideration.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

DEFENSES OF CHARLESTON.

Fort Moultrie, Charleston Harbor, South Carolina, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This work is located on Sullivan's Island, and co-operates with Fort Sumter in defending the water approach from the sea to the city and harbor of Charleston. It is an earthen barbette work, and was commenced in 1841.

The completion of the work comprises the construction of eleven permanent gun-platforms and breast-height walls, bonnets on the traverses, a portion of the masonry and all the earth covering of the bomb-proof shelter, the postern gallery, a part of the earth covering of the magazines, and an earthen cover face on the channel front.

The work done during the last fiscal year consisted in covering the exposed concrete over the sally-port and guard-rooms to protect it from the weather, in repairing the fort-keeper's house, and the fences surrounding the outside grounds, and clearing the latter from rubbish.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$50,000 00

Fort Sumter, Charleston Harbor, South Carolina, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This casemated work is located on a shoal on the south side of the entrance into the harbor, and its guns, crossing their fire with those of Fort Moultrie on Sullivan's Island, command the only channel of approach thereto practicable for vessels of war.

Its construction was begun in 1829, and was nearly finished, although still wanting most of its armament, when, in April, 1861, it was captured by the Confederate forces. It was held by them until February 18, 1865.

The reconstruction of the work with the view of adapting it to the conditions of modern defense was begun in 1870, and is now well advanced. Of the barbette gun-platforms required eight have been laid. Three of these eight are permanent and five are of timber, four of the

DEFENSES OF CHARLESTON—Continued.

latter being occupied by two 15-inch guns and two 200-pounder Parrott rifles.

By replacing two platforms on the southeast face now occupied by light guns with heavy platforms, timber for which has already been provided, the work would be ready for its barbette armament. Eight casemates on the northwest face are ready for the guns except the traverse circles, and the nine casemates on the northeast face, one in the *pan coupè* between the northeast and north faces, and one adjacent thereto on the north face (11 in all) are armed.

The completion of this work comprises the construction of seven permanent gun-platforms and their breast-height walls, placing bonnets on the traverses, most of the earthwork on the gorge face and the parades and magazines adjacent thereto, the arrangement of a room for torpedo defense, and the repair and extension of the wharf and other matters of detail.

The work done during the last fiscal year consisted in replacing with a timber revetment the old marsh-sod revetment in front of guns 6 and 7 on the northeast face, and guns 9 and 10 on the southeast face, and in beginning the extension of the wharf. This extension was to be completed in July or August of the present fiscal year.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.	
Appropriation asked for next fiscal year	$50,000 00

Fort Johnson, Charleston Harbor, South Carolina, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This old work, situated on James Island, a little more than 1¼ miles west of Fort Sumter, should constitute one of the inner works in the system of defense for this locality.

It is a fort only in name, having neither armament nor magazines, but only some irregular mounds of earth representing what remains of the battery found there at the close of the civil war.

The project for reconstructing this old work contemplates making it a battery for heavy guns and sea-coast mortars. Timber platforms for the mortars have been procured.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.	
Appropriation asked for next fiscal year	$20,000 00

Castle Pinckney, Charleston Harbor, South Carolina, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This work, situated on Shute's Folly Island, about one mile east of the city of Charleston, is one of the interior works in the system of defense of the harbor. The work was commenced in 1829. In its present condition it is useless for defensive purposes, and is now in charge of the Light House Board for light-house purposes.

An expenditure of about $10,000 will be required to adapt this work to the reception of an armament.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

DEFENSES OF SAVANNAH.

Fort Jackson, Savannah River, Georgia, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This work, commenced in 1842, is situated about four miles from the city of Savannah, and forms the inner line of defense for that city.

Modifications of this work, approved January 11, 1870, so as to fit it for the reception of heavy guns, were commenced in the fiscal year ending June 30, 1873, but they were suspended some years since for want of appropriations.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$10,000 00

Fort Pulaski, mouth of Savannah River, Georgia, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This casemated work, commenced in 1829, is located on Cockspur Island, covers the ship channel leading from Tybee Roads into the Savannah River, and constitutes the principal defense of the city of Savannah against naval attack.

From 1872 to 1875 the work of remodeling the demilune was carried on at intervals and nearly completed. Its gun-platforms were built of timber, and two 15-inch guns were mounted on the north face. All these platforms are more or less decayed.

Nothing has been done as yet toward making the required modifications of the main work except to lay the foundations of nearly all the piers for extending the casemates on the north face.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$75,000 00

New fort on Tybee Island, mouth of Savannah River, Georgia, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—Plans have been prepared for defensive earthen works to be constructed on the north point of Tybee Island, for the double purpose of preventing the occupation of Tybee Roads by hostile vessels and defending the channel of approach to the Savannah River.

The land necessary for the work was acquired by the United States in 1875.

No appropriation for their construction has yet been made.

Appropriation asked for next fiscal year	$50,000 00

DEFENSES OF CUMBERLAND SOUND.

Fort Clinch, Amelia Island, Florida, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This casemated work, commenced in 1847, defends the entrance into Cumberland Sound, and is in an unfinished condition. A plan for modifying the work has been prepared by the Board of Engineers for Fortifications, which contemplates an armament of rifled guns and the construction of an exterior earthen battery for 12-inch rifled guns.

A recent survey of the entrance into Cumberland Sound for purposes

DEFENSES OF CUMBERLAND SOUND—Continued.

of channel improvement having shown that the site of Fort Clinch and the security of the work is threatened by the encroachments of the sea, arrangements were made, and contracts entered into, for the construction of 4 or 5 spur jetties of riprap stone, supported by platforms of heavy logs, in order to restore the shore-line and afford protection to the site. These jetties were not quite finished at the close of the last fiscal year. The results have been satisfactory.

The work of roofing over the five tower bastions, fixing new leaders to quarters, boarding up windows, doors, and embrasures, repairing roof on barracks, &c., for protection against the weather, was in progress, but not completed at the close of the fiscal year.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$50,000 00

DEFENSES OF SAINT AUGUSTINE.

Fort Marion, Saint Augustine, Florida, in charge of Lieut. Col. Q. A. Gillmore, Corps of Engineers.—This work is intended to defend the harbor and city of San Augustine. It was built by the Spaniards, and was called by them San Marco. It was essentially completed in the year 1756, its construction having extended through a period of more than one hundred years. It is built of coquina, a natural shell concrete found in the vicinity. No money has been expended by the United States for the maintenance of the work, or in arresting the progress of ordinary deterioration and decay, for the reason, doubtless, that the water battery constructed in front of it in 1842–'43 will, if suitably armed, furnish a sufficient defense for this locality. The main work is not suitable for an efficient defense.

Should it be desired to restore old Fort San Marco, both main work and demilune, to the condition substantially in which it was left by the Spaniards, it can be done, so far as it is possible to attain this object, and omitting all preparations for an armament, for from $10,000 to $12,000.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

DEFENSES OF KEY WEST.

Fort Taylor and batteries, Key West, Florida, in charge of Capt. W. H. Heuer, Corps of Engineers.—These works, comprising the main casemated work on a submarine foundation and earthen batteries on the island, are for the defense of the important harbor of Key West. The main work was commenced in 1844.

The exterior earthen batteries for heavy guns, projected by the Board of Engineers for Fortifications, and commenced in 1872, were left incomplete at the close of the last fiscal year, for which an appropriation for this work was made (1875–'76).

During the year, on account of the small amount of money available no work was done to the fort proper or batteries. A fine bridge 720 feet long by 22 feet wide, resting on 70 piers built of concrete and brick, was finished, which connects the island of Key West with the fort. A new wooden bridge 80 feet long by 11 feet wide was also built over the ditch. The warehouses, stables, carpenter shop, and other engineer buildings outside the fort were repaired sufficiently to properly protect the government property which they contain.

The barracks and quarters within the fort are in bad order. To put them in good order will cost about $15,000. The masonry of the fort is in good order.

The two Martello Towers are in fair condition. They were constructed in the early part of the war on private land, the title to which has never been acquired by the United States.

For certain necessary repairs to the main work and buildings, for rebuilding bridge, and for continuing the construction of the exterior batteries for modern guns of large caliber, an appropriation is recommended.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year:

For repairs of buildings, and continuing the construction of the exterior batteries	$67,000 00
For acquisition of sites of the two Martello Towers, by purchase or condemnation	2,500 00
	69,500 00

DEFENSES OF THE HARBOR OF DRY TORTUGAS.

Fort Jefferson, Garden Key, Tortugas, Florida, in charge of Capt. W. H. Heuer, Corps of Engineers.—This casemated work, commenced in 1846, perfectly commands the admirable harbor lying in the heart of this group of keys.

During the past fiscal year operations were restricted to caring for the public property and buildings.

The modifications of this work, designed by the Board of Engineers for Fortifications, are in an incomplete condition, and for continuing the same, including the erection of stone platforms for heavy rifled guns and for necessary repairs to the work, an appropriation is recommended.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$28,000 00

DEFENSES OF PENSACOLA HARBOR AND NAVY-YARD.

Fort Pickens, Pensacola Harbor, Florida, in charge of Capt. A. N. Damrell, Corps of Engineers.—This casemated work, commenced in 1828, with Fort Barrancas and the proposed new batteries near the site of Fort McRee, constitute the defenses of the town and harbor of Pensacola, and the navy-yard at Warrington. It is situated near the west end of Santa Rosa Island, and is, at present, the only work of defense to the entrance and main channel to Pensacola Harbor.

From 1869, when a new platform for a 15-inch gun in west bastion was completed, until 1873, operations were confined to general repairs. In December, 1873, operations were commenced to change the center pintle platforms into front pintle platforms for mounting new armament; after the completion of eight of these, work was suspended (in February, 1874) for want of funds, and operations were again confined to general repairs until January, 1876, when a kitchen and mess-hall were built, preparatory to commencing work on the modification of the fort, according to an approved plan of the Board of Engineers for Fortifications. Work on the bastions C and D was carried on until August, 1876, when, funds being again exhausted, operations had to be suspended. With the exception of the gun-platform on bastion C, both bastions were completed.

The importance of this work, on account of its location, makes it desirable that the modifications to the fort and the construction of sand batteries, as recommended by the Board of Engineers for Fortifications, should be carried out at an early day; and an appropriation of seventy-five thousand dollars could be profitably expended on these works during the fiscal year ending June 30, 1883.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$75,000 00

Fort Barrancas and redoubt, Pensacola Harbor, Florida, in charge of Capt. A. N. Damrell, Corps of Engineers.—These works, commenced in 1839, are situated on the north bank of the entrance of Pensacola Harbor, opposite to Fort Pickens, and are intended for defense of this entrance and protection from land attacks.

For many years operations at this work were confined to necessary repairs to masonry, slopes, and woodwork, until 1874, when the construction of four front pintle platforms for mounting new ordnance was commenced; but work was suspended before much progress was made, none of the platforms having been completed. Since that time operations have again been confined to ordinary repairs. Portions of the fencing around the fort and redoubt have been rebuilt during the past fiscal year.

Plans and estimates for the construction of an exterior battery on the bluff west of the fort have been prepared by the Board of Engineers for Fortifications, but so far no appropriations have been made and no work has been done.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$50,000 00

Fort McRee, Pensacola Harbor, Florida, in charge of Capt. A. N. Damrell, Corps of Engineers.—This fort, situated on the west side of the main ship channel to Pensacola Harbor, commenced in 1836, has been a ruin since the late war; and the greater portion has been washed away by the encroachment of the sea upon its site.

Plans for the construction of batteries for the heaviest modern guns and mortars near the site of the old fort, to co-operate with Fort Pickens and the works at Barrancas in the defense of this important harbor, have been prepared by the Board of Engineers for Fortifications, but

DEFENSES OF PENSACOLA HARBOR AND NAVY-YARD—Continued.

as no appropropriation has been made for them no work was done upon them.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$50,000 00

DEFENSES OF MOBILE.

Fort Morgan, eastern entrance to Mobile Bay, Alabama, in charge of Capt. A. N. Damrell, Corps of Engineers.—This casemated fort, commenced in 1819 and completed in 1833, is situated at Mobile Point, on the east side of the main ship channel to Mobile Bay, and as it commands this channel from the outer bar to the lower anchorage, and forms with Fort Gaines on the west side of the channel the outer line of defenses to the harbor and port of Mobile, its site is of great importance, but will not be of much value as a defensive work until the contemplated water batteries for heavy ordnance, along the western and southern shore, are completed. As stated in my last year's report, the construction of these batteries was commenced in September, 1875; but work had to be suspended in April, 1876, the amount appropriated being exhausted; and as no appropriations have been made since, this work has not been resumed.

During the winter of 1873–'74, twelve of the old barbette gun platforms on the channel front of the fort were changed for 200-pound Parrott gun-platforms; and the guns mounted on these are the only guns now serviceable. The sea-wall completed to a distance of 1,300 feet south of the wharf, in 1878, for the protection of the site of the fort, was badly injured by the heavy storms in December, 1879, by being partially undermined near its southern end; and a brush apron, with stone ballast, was put in front of that section of the wall.

After a heavy gale during February, 1881, it was found that the water almost along the entire length of the wall had deepened to such an extent as to threaten its destruction by undermining, and an allotment of $3,934.75 was made from the general appropriation for preservation and repair of fortifications for the protection of the wall. During the months of April, May, and June, an apron constructed of brush mattrasses sunk with rock ballast has been put in front of the wall where the greatest wash had taken place, and so far has prevented further damage. In the construction of this apron 936 cubic yards of mattrasses and 1,500 cubic yards of rock ballast were used, and 468 cubic yards of sand and clay were hauled for back-filling.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$75,000 00

Fort Gaines, Dauphin Island, Alabama, in charge of Capt. A. N. Damrell, Corps of Engineers.—This work, commenced in 1848, is, with Fort Morgan, on the opposite side of the main entrance to Mobile Harbor, designed to command that entrance and the lower fleet-anchorage. It needs complete modification to adapt it to the use of modern heavy guns, and plans therefor have been prepared by the Board of Engineers for

DEFENSES OF MOBILE—Continued.

Fortifications; but no appropriations having been made for this work, the fort remains in the same condition as reported last year.

The palmetto jetties erected for the protection of the site of this fort from abrasion by the sea have been very much damaged by floating logs during the past year, and the officer in charge designs to submit a plan for a more permanent protection as soon as necessary surveys can be made.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$50,000 00

DEFENSES OF MISSISSIPPI SOUND.

Fort on Ship Island, in charge of Capt. A. N. Damrell, Corps of Engineers.—This casemated fort, commenced in 1862, is located at the west end of Ship Island, on the east side of Ship Island channel, and is designed for the defense of a maritime depot of coal, provisions, &c.; of the navigation of Mississippi Sound, and of the approaches to New Orleans from the eastward.

During a heavy gale in February, 1881, the whole island was flooded, and some damage was done to the store-house and quarter-building, which was, however, repaired before the close of the year.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

DEFENSES OF NEW ORLEANS.

Fort Pike, Rigolets Pass, Louisiana, in charge of Maj. C. W. Howell, Corps of Engineers.—This casemated work, commenced in 1819, is located on the south side of the Rigolets, a pass connecting Lake Pontchartrain with Mississippi Sound and the Gulf of Mexico. It was designed to guard the extreme eastern approach to New Orleans available for vessels drawing seven feet or less.

During the late civil war, while in the possession of the Confederates, with the aid of obstructions in channel, it served to prevent predatory incursions of light-draught steam gunboats of the United States Navy into Lake Pontchartrain, which, no doubt, but for it, would have cut off direct communication by the lake and by rail between New Orleans and the country east of the Mississippi River.

Since 1862 the work has been kept in about the same condition it was then, except as to armament and garrison, both of which have since been removed.

A project for the modification of this work, to adapt it for the reception of modern ordnance, was prepared by the Board of Engineers for Fortifications in 1870, but no appropriation has been made therefor.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$24,000 00

Fort Macomb, Chef Menteur Pass, Louisiana, in charge of Maj. C. W. Howell, Corps of Engineers.—This work, commenced in 1822, is located on the south side of the "Chef Menteur," a pass connecting Lake Pontchartrain with Lake Borgne and the Gulf of Mexico. It covers the approach to New Orleans of vessels drawing four feet or less *via* the pass and Lake Pontchartrain, and also the practicable approach of a land force from the pass *via* the "Gentilly Ridge," and the line of the New Orleans, Mobile, and Chattanooga Railroad, which crosses the pass but a few hundred yards from the fort.

A project for the modification of this work, to adapt it for the reception of modern ordnance, was prepared by the Board of Engineers for Fortifications in 1870, but no appropriation has been made therefor.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year $24,000 00

Tower Dupré, Lake Borgne, Louisiana, in charge of Maj. C. W. Howell, Corps of Engineers.—This tower, commenced in 1830, is located at the mouth of Bayou Dupré, a bayou connected with Lake Borgne and heading near the Mississippi River, about 12 miles below the city of New Orleans. It is one of the system of works designed to command the approaches to New Orleans from Mississippi Sound.

It was mainly through this bayou that the British forces approached New Orleans in 1814.

About 1873 and 1874 the bayou was converted into a canal by widening and straightening it in places and by excavation extending to within a few hundred feet of the Mississippi River. A pier was also extended into the lake. Vessels drawing four feet or less can now easily pass from the Gulf of Mexico via this canal to its end near the river.

Since the late civil war but little has been done to this work, and for the past few years nothing has been done. The tower is at present in a fair state of preservation. The parapet of the battery has nearly all been removed, and there is no armament. In case of necessity the work can be put in condition in a few days to receive a section of a battery of rifled field guns and a suitable garrison.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

Battery Bienvenue, Lake Borgne, Louisiana, in charge of Maj. C. W. Howell, Corps of Engineers.—This battery, commenced in 1826, is situated in the sea marsh at the junction of the two main branches of Bayou Bienvenue, and about three miles from the mouth of the bayou. It was designed to guard against boat expeditions from Lake Borgne *via* this bayou to attack New Orleans in the rear of the lower portion of the city.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

Tower at Proctorsville, Lake Borgne, Louisiana, in charge of Maj. C. W. Howell, Corps of Engineers.—This work, commenced in 1856, is one of the system of works designed to command the approaches to New Orleans from Mississippi Sound. No work was done during the past fiscal year.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

DEFENSES OF NEW ORLEANS—Continued.

Fort Jackson, Mississippi River, Louisiana, in charge of Maj. C. W. Howell, Corps of Engineers.—This work, commenced in 1822, is situated on the right (west) bank of the Mississippi River, at what is known as the Plaquemine Bend, about 70 miles below the city of New Orleans.

Together with Fort Saint Philip, situated on the opposite bank of the river, it was intended to serve in the defense of the very important port of New Orleans and its surrounding country against attack of a hostile fleet attempting their capture by way of the river.

It is an inclosed casemated work, with masonry scarps and new exterior earthen batteries, which are in an incomplete condition.

For needful repairs to the work, completing new earthen batteries, and for continuing preparations for mounting an armament of heaviest caliber, the modifications of this work, designed by the Board of Engineers for Fortifications, to adapt it for the use of modern heavy ordnance being incomplete, an appropriation is asked.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$25,000 00

Fort Saint Philip, Mississippi River, Louisiana, in charge of Maj. C. W. Howell, Corps of Engineers.—The location and purpose of this work, which was commenced in 1841, are sufficiently described in the preceding report on Fort Jackson.

It is fully as important to be maintained and properly armed as Fort Jackson. Although the latter is the larger work, the position of the former is more advantageous.

It is an inclosed barbette work, with masonry scarp and new exterior earthen batteries, which are in an incomplete condition.

For needful repairs to the main work, and for continuing the construction of the exterior earthen batteries of heavy guns which have been designed by the Board of Engineers for Fortifications, and which are yet incomplete, an appropriation is recommended.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$25,000 00

Fort Livingston, Barataria Bay, Louisiana, in charge of Maj. C. W. Howell, Corps of Engineers.—This work, commenced in 1842, is located on the west end of Grande Terre Island, at the entrance to Barataria Bay, and guards the western line of approach to New Orleans offered by the bay, and the bayous and canals connecting the bay with the Mississippi River opposite New Orleans. It also secures the anchorage in the bay as a harbor of refuge for coasting or other light-draught vessels in time of war.

The location is likely to be given even greater importance than in the past, because of the projected Barataria ship-canal, and the canal already far advanced connecting the bay with Bayous Lafourche and Terrebonne and the Atchafalaya.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

DEFENSES OF GALVESTON.

Batteries at the entrance to the harbor of Galveston, Texas.—The object of the earthen batteries of heavy guns, recently designed by the Board of Engineers for Fortifications, to be placed on Pelican Spit, Galveston Island, and Bolivar Point, is for the defense of the entrance to the harbor of Galveston, a harbor rapidly increasing in commercial importance. No appropriation for the construction of these works has yet been made.

Appropriation asked for next fiscal year	$50,000 00

DEFENSES OF SAN DIEGO HARBOR.

Fort at San Diego, California, in charge of Lieut. Col. C. S. Stewart, Corps of Engineers.—This earthwork, situated in rear of Ballast Point, commands the channel at the entrance to the bay and harbor of San Diego.

The first and only appropriation for it was an appropriation of $50,000 for the fiscal year 1873–'74; under it work was commenced in 1873, and considerable progress was made, but in its present unfinished state this battery is utterly worthless for defensive purposes. Its position wholly controls the entrance to the important harbor and bay of San Diego, every vessel going in necessarily passing close to the work.

The embankment of the faces of the battery was raised to the level of the parade, and the concrete masonry of the walls of one service magazine built to the spring of the arch.

The watchman in charge of the public property has made the repairs to embankments which have been required; has cleaned water-tanks, and has improved the catch-water drains in the hillsides and around the public buildings. He reports everything in good condition.

To complete this work so that it may receive its armament of fifteen heavy guns requires the construction of everything above the level of the parade; that is, of parapets, magazines, terrepleins, breast-height walls, platforms, and communication. It is estimated about $135,000 will be required for these. An appropriation of $70,000, to be applied to the masonry of magazines, breast-height walls, and gun platforms, and so much of the earthwork connected therewith as possible, is asked for the year ending June 30, 1883.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$70,000 00

DEFENSES OF SAN FRANCISCO, THE NAVY-YARD AT MARE ISLAND, AND THE ARSENAL AT BENICIA.

Fort at Fort Point, entrance to San Francisco Harbor, California, in charge of Lieut. Col. C. S. Stewart, Corps of Engineers.—This casemated work, commenced in 1853, and its exterior earthen barbette batteries, commenced in 1870, form the defenses of the south side of the Golden Gate, the entrance to San Francisco Harbor.

The main casemated work has been occupied by a garrison.

Minor repairs to the quarters, in matters of sewage, &c., tending to the welfare and comfort of the occupants, and not interfering in any way with the defense, have been made with the sanction of the Engineer Department by the Quartermaster's Department.

DEFENSES OF SAN FRANCISCO, THE NAVY-YARD AT MARE ISLAND, AND THE ARSENAL AT BENICIA—Continued.

The iron work of the embrasures has been painted and kept in order, so far as practicable, by the watchmen. Owing to the action of wind, water, and changes of temperature, the pointing of the brick scarps and casemate arches is steadily wearing away and dropping out. In a few years its extensive renewal will be needed.

The sea-wall is in general in good order. The heavy stones of the apron at its base have in places, in past years, been considerably disturbed by the sea. No great change in this apron seems to have taken place since the last annual report.

The magazines, so far as reported, are in good condition. The general state of this work, subject to the usual annual wear and tear, is as it has been in past years.

At the earthen barbette batteries exterior to the fort, during the year, the watchmen have made repairs to the sodding of slopes, to drains, fences, wharf, and buildings. The latter have been whitewashed. Some of them are of little value.

Portions of the sodded slopes of parapets and traverses have been removed. Strictly speaking, there is here no such thing as sod. What is so called consists of the thin and not matted roots of weeds and grasses. Without great labor and expense it is not possible, therefore, to keep the slopes looking well during the long dry season. From past experience those most exposed to the sun and the strong, steady winds of summer stand best when not mowed. The long weeds and grasses act as a mat to keep the light, dry soil, loosened and pulverized by the burrows of gophers and like animals, from being blown away. Therefore a great part of such slopes has not been mowed. Taking into view the climate, this want of good sod, and the fact that no appropriation which would permit more than small repairs has been made for five years, these batteries are now in tolerably good order.

Thirteen traverse magazines are finished. Sixteen more can be used if necessary. Twelve timber platforms for heavy mortars are in place. They are deteriorating.

To prepare the exterior earthen barbette batteries of this very important position for receiving their armament of the heaviest modern guns and mortars, under existing plans designed by the Board of Engineers for the Pacific Coast, and to make good the damages since the cessation of work in 1876, will require, it is estimated, $115,000. This sum could be applied to the completion of thirty platforms for heavy guns, together with the traverses, service magazine, terreplein, and communications corresponding thereto.

No work upon these batteries has been done since 1876, for want of funds, and the importance of an efficient protection of the city of San Francisco, the navy-yard at Mare Island, and the United States arsenal at Benicia warrants an early and adequate appropriation therefor.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$100,000 00

Fort at Lime Point, San Francisco Harbor, California, in charge of Lieut. Col. George H. Mendell, Corps of Engineers.—The system of works projected for the defense of the Golden Gate from the northern shore

DEFENSES OF SAN FRANCISCO, THE NAVY-YARD AT MARE ISLAND, AND THE ARSENAL AT BENICIA—Continued.

consists of a casemated work to be built at Lime Point, and detached earthen barbette batteries on Point Cavallo; on Lime Point Ridge, at Gravelly Beach, and on Point Diablo.

Some work was done in 1867 and 1868 on the excavation of the site of the casemated work, but it remains incomplete. The Point Diablo Battery was never begun. The other barbette batteries were under construction from 1870 to 1876, but are incomplete, with the exception of the Gravelly Beach Battery.

In order to complete the batteries begun, and to restore the wharf and other structures damaged during the suspension of operations, the sum of $100,000 will be necessary, $80,000 of which can be profitably applied during the fiscal year beginning June 30, 1882. This sum will be applied to the construction of platforms, and necessary repairs and equipment.

The batteries have been under the care of keepers, and remain in good condition, not differing greatly from that reported in the last annual report.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$80,000 00

Fort on Alcatraz Island, San Francisco Harbor, California, in charge of Lieut. Col. George H. Mendell, Corps of Engineers.—Alcatraz Island lies in the harbor of San Francisco, two miles inside its entrance, in a very advantageous position for the defense of the channels on every side of it.

In 1870 the work of remodeling the defenses of this island to adapt them to modern ordnance—this work consisting of the construction of heavy earthen batteries—was commenced and carried on for a few years, when it was suspended for want of funds. The last appropriation ($25,000) was for the fiscal year 1875–'76, although there was some work done, mostly by the military prisoners confined on the Island, in 1877.

The appropriation asked for will be applied to the construction of gun-platforms for earthen batteries ready to receive them, and to the construction of earthen batteries not yet commenced.

No appropriation having been made, no work was done at this fortification during the last fiscal year beyond its protection, preservation, and repair, as far as was possible with the general appropriation made for this purpose, and no other work is contemplated during the current fiscal year for the same reason.

Appropriation asked for next fiscal year	$50,000 00

Batteries at Point San José, San Francisco Harbor, California, in charge of Lieut. Col. C. S. Stewart, Corps of Engineers.—During the late civil war two temporary earthen batteries were built on this point.

In the east battery the timber platforms are decayed as well as the wood-work of the magazines, part of which has caved in. This battery is unserviceable.

The three platforms on the right of the west battery are new, having been put down at the end of the last fiscal year, and the guns for them have been remounted during this year. The timber of the remaining platforms is much decayed. The traverse magazine of timber is in good condition and in use.

DEFENSES OF SAN FRANCISCO, THE NAVY-YARD AT MARE ISLAND, AND THE ARSENAL AT BENICIA—Continued.

Projects for new earthen batteries of heavy guns and mortars for the occupation of this important point in the second line of defense for the bay and harbor of San Francisco have been prepared by the Board of Engineers for the Pacific Coast.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

Batteries on Angel Island, San Francisco Harbor, California, in charge of Lieut. Col. C. S. Stewart, Corps of Engineers.—The three earthen batteries on this island were built during the late civil war for temporary use. The timber platforms and the timber magazines are decayed, and nearly all the gun-carriages have been condemned.

The batteries are practically unserviceable.

Barbette earthen batteries for the heaviest guns have been planned by the Board of Engineers for the Pacific Coast, to occupy the most valuable positions on the island which bear on the channels leading to the upper part of the bay, to the navy-yard at Mare Island, and to the arsenal at Benicia.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

DEFENSES OF THE COLUMBIA.

Defenses at the mouth of the Columbia River, Oregon, and Washington Territory, in charge of Maj. G. L. Gillespie, Corps of Engineers.—The defenses consist of Fort Stevens, an inclosed earthwork at Point Adams, Oregon, on the south side, commanding the entrance to the Columbia River by the south channel, which, after passing the outer or northern end of Clatsop Spit, skirts the eastern shore of Point Adams on the approach to Astoria; and the earthen batteries at Fort Canby, Cape Disappointment, Washington Territory, on the north side, commanding the entrance by the north channel, which passes in close to the headland, leaving Sand Island to the southward.

These earthworks were built during the late civil war in anticipation of complications with foreign powers. The breast-high retaining walls of the parapets, the walls and roofs supporting the earth coverings of magazines, the gun-platforms, nad other parts which are commonly built of masonry in permanent earthworks, were, in this case, necessarily built of wood, for want of time and money, and they are subject to rapid decay in the climate of the mouth of the Columbia.

At Fort Canby a small quantity of metallic paint and oil was purchased to paint the powder magazine located near the light-keeper's dwelling. No other repairs were made during the year.

Funds will be provided from the appropriation for protection, preservation, and repair of fortifications for the current fiscal year for rebuilding two gun platforms in the center, and two in the left battery, and keeping the powder magazine in repair.

At Fort Stevens the sallyport was wholly rebuilt, and the floor, as well as the connecting bridge across the ditch, was raised ten inches to prevent high water obstructing the entrance; the revetment of the traverses on either side of the 15-inch gun were rebuilt and the earth sodded and the interior revetment at other points on the sea faces was repaired.

Funds will be provided from the appropriation for protection, preser-

DEFENSES OF THE COLUMBIA—Continued.

vation, and repair of fortifications for rebuilding two gun platforms on the sea front, and for renewing part of the interior revetment.

No appropriation was made for the fiscal year ending June 30, 1882.
No appropriation asked for next fiscal year.

BOARDS OF ENGINEERS.

THE BOARD OF ENGINEERS.

The Board of Engineers stationed at New York City, consisting of Col. Z. B. Tower, Col. John Newton, Lieut. Col. Henry L. Abbot, and, when so ordered, the officer in charge of the work under consideration, has been engaged in the duties which have from time to time been referred to it, and it has submitted the following summary of its operations:

Coast Defenses.—Each year's progress on the part of maritime nations for attacking land forts constructed for the protection of coastwise harbors has revealed more and more the necessity for important and radical changes in our own sea-coast defenses. From the great advance made in the power of guns mounted on war ships during the past twenty years, and in the resistance of their iron armor to projectiles, by which they are enabled without great risk to approach near enough to shore batteries to give efficiency to their own fire, it seems to be generally conceded that earth parapets and iron shields are the most suitable cover for shore guns yet arrived at. The earth parapet commends itself by its comparative cheapness, and there are many positions in which it can be used effectively; and the more so if the guns which it covers are mounted on carriages permitting them to be depressed for loading without exposing the gunners to direct fire. Of course the objection to a barbette battery always remains, that it does not protect against highly curved and vertical fire. The combination of iron shields with masonry scarps, regarded as admissible some years ago, is not now looked upon with the same favor; in fact, the development of the 80 and 100 ton guns, the improvement in projectiles and their initial velocities, seem to have rejected that method of construction for forts. The question naturally arises, how can iron be used to cover shore guns most economically and most efficiently? It is a question as between forts with iron scarps and turrets, and perhaps one mainly of relative cost. If the latter be the more expensive, gun for gun, it gives a full circle of fire to compensate for the greater outlay in its construction. The turret seems to be especially appropriate for the most important harbors of our coast, from the fact that the forts in existence furnish casemate cover for garrisons and munitions of war, which can be made secure without large outlays. In adding turrets, therefore, casemate room only large enough for their service need be added when they are placed outside of the fort; if within, additional casemates will not generally be required. This Board is entirely in favor of using iron turrets for sea-coast defense in the most important harbors of the United States.

A large number of barbette batteries have been commenced, and in many localities advanced nearly to completion. They will be suitable, when finished, for the reception of 12-inch rifled guns.

The turrets should be designed and built for an 80 or 100 ton gun, as the most powerful yet constructed. During the past year our studies have been directed to designing a turret for a 100 ton gun, a report upon which has already been submitted.

Reports upon questions relating to fortifications have been made during the year as follows:

1880. November 16. Upon device of Lieut. G. N. Whistler, U. S. A., for a hydraulic gun-carriage.

December 27. Upon application of the State of New York for permission to use a portion of the Fort Porter military reservation for canal purposes.

1881. January 11. Upon question of granting right of way through public lands of the United States near Fort Wadsworth, Staten Island, N. Y., for railroad purposes.

January 27. Upon proposition of Mr. Robert B. Lines, agent, to sell to the United States Government the right to manufacture the Whitehead-Luppis torpedo.

February 9. Supplementary report upon same subject.

January 27. Upon invention of Mr. Newton F. Hartshorn, of balloons for war purposes.

April 16. Upon paper of Professor Höfer on theory of blasting and military mining; translated by Capt. C. W. Raymond, Corps of Engineers.

May 4. Upon plan of Mr. W. M. Stehley for "elastic armor" for war vessels.

June 30. Upon subject of further defense of Boston Harbor by means of turrets and additional barbette batteries, with accompanying drawings.

June 30. Upon a design made by this Board of a turret for harbor defense, with accompanying drawings.

Torpedo Defense.—The annual appropriation made for the fiscal year 1880–'81, for providing materials to defend our coasts with submarine mines, &c. ($50,000), has been expended, upon the recommendation of this Board, chiefly in the purchase of torpedo cases and junction boxes to be stored for use in the channels leading to the harbor of Boston. A much larger sum could have been judiciously expended in providing for other important harbors now quite neglected; and an increase in this appropriation for the coming year is urgently to be recommended. The material is not liable to deteriorate in store; and in the present condition of our sea-coast defenses, and of their armaments, an ample supply of torpedoes is a necessity which cannot be ignored without risk of disaster. Not less than $100,000 should be annually applied to this purpose for several years to come.

Another matter in this connection demands immediate action. In our last annual report, this Board pointed out in some detail the necessity for a special appropriation to prepare our forts to serve as operating stations for submarine mines. Without such preparation only a very imperfect use could be made of the materials in store. Unless the electric cables connecting the mines with the casemate containing the batteries, &c., are so introduced as to be secure against bombardment, a single fortunate shot may open the whole channel to the enemy. This would be the condition of Boston to-day, and indeed of most of our great seaports. It is useless to provide mines without also constructing the shafts, galleries, and bomb-proofs necessary for their efficient service. An appropriation of $200,000 would go far towards supplying all our chief forts with these most necessary additions, and the appropriation of that sum is again recommended. The works require time for their construction, and at the outbreak of hostilities this would certainly be lacking.

It is the duty of the Board to again urge the importance of increasing the number of enlisted men of engineers sufficiently to properly prepare for the service of our submarine mines in war. At present, owing to the reduction of the Army and to the need of troops on the plains, only about 100 men would be available in an emergency—hardly enough to defend the port of New York City. The service is technical, requiring qualifications and training not to be found in details from other arms of the service or among the volunteers. No change in the organic law creating the Battalion of Engineers is required, but simply a provision authorizing it to be recruited to its full strength (752 enlisted men) in addition to the 25,000 men to which the Army is now limited. The Signal Service is already provided for upon this plan, which has also received the favorable indorsement of the General of the Army in his annual report for 1879. No increase of commissioned officers nor change in legal organization would be needful; and the men, being thoroughly disciplined and well drilled as infantry, would be as serviceable in ordinary emergencies as those of any other arm of service.

The experimental development of our system of submarine mining has been continued, as heretofore, at Willets Point; the expense being reduced to a minimum by the employment of the engineer troops in the needful mechanical operations.

Under the head of "explosives," Noble's latest improvement in the class of nitro-glycerine compounds, known as explosive gelatine, has received attention. The private manufacture of this material for our market, although under consideration, is not yet definitely arranged and under existing navigation laws it has been found impossible to import it from Europe. No facilities have been provided for manufacturing explosives in bulk at Willets Point, as the private establishments of the country are sufficient to supply all probable requirements. For these reasons it has been found necessary to delay these experiments longer than was at first expected; but, through the kindness of Captain Ramsay, U. S. N., commanding the naval torpedo station at Newport, we have recently been presented with an excellent sample of about 100 pounds, made there by Professor Hill, and are thus enabled to compare this new explosive with those already carefully studied for use in submarine mines.

The sample was made upon the usual formula: 89 per cent. of nitroglycerine; 7 per cent. of soluble gun-cotton; 4 per cent. of camphor. The substance was an elastic jelly, amber-colored and sufficiently tough to be cut with a knife in strips. Water caused no exudation of nitroglycerine, nor did explosion occur from the impact of a bullet fired at short range; two important advantages over dynamite.

Tested for intensity of action when fired under water, by the ring method in use at Willets Point, the new explosive gave better results than any heretofore obtained, proving to be about 17 per cent. stronger than dynamite No. 1. The curious fact was developed that several distinct orders of explosion are possible, depending upon the nature of the primer employed. Thus, with 3 ounces of gun-cotton or dynamite No. 1, ignited by 20 grains of fulminating mercury, complete detonation appeared to be secured; giving normal results well represented by the formula.

$$P = \left(\frac{6636\ (\delta + 259)\ C}{(D + 001)\ 2.1} \right)^{\frac{2}{3}}$$

In which P denotes the mean instantaneous pressure, in pounds, per square inch of exposed surface, which would be registered upon the copper disk of a Rodman pressure gauge; δ, the vertical angle made by a line drawn from the center of the charge to the object receiving the shock, measured from the nadir; C, the charge of the explosive in pounds; and D, the distance from the charge to the object, in feet. This formula, framed by Lieutenant-Colonel Abbot, appears to be general in its application to all the modern explosive compounds, when the proper number replaces 259 in the numerator. For dynamite No. 1 this number is 186; for gun-cotton 135, &c.

If, however, the charges of explosive gelatine be fired by an ordinary torpedo fuze primed with 20 grains of fulminating mercury in a copper cap, explosion usually occurs (only two failures in eighteen trials), but, as a rule, much less intensity of action is developed; and, as the size of the charge is increased, this difference appears to become greater. Thus in these trials the measured intensities ranged from unity to $\frac{2}{10}$ of perfect detonation, the charges varying from 1 pound to 5 pounds. Special primers of a much more powerful character than those in use with the older explosive compounds are thus proved to be necessary, as, indeed, was anticipated from foreign notes upon the subject.

Although these experiments with explosive gelatine prove that it possesses certain merits which must constitute it a strong rival to dynamite No. 1 in submarine mining, more extended trials are needful before a final decision can be reached. Such trials will be made without unnecessary delay. For use in military demolitions and in similar work devolving upon the engineers of an army in the field, its strength and safety in handling will undoubtedly place it in the first rank.

As stated in the last annual report of the Board, a systematic series of experiments with Sim's electrical fish torpedo is in progress at Willets Point. Ten official runs and over thirty wharf trials were made last summer and autumn to determine the capabilities and defects of the invention, to fix upon the best form of propeller, and to settle other practical points connected with the working of the apparatus. During the past winter certain improvements suggested by these experiments have been made in the boat and in the shore machinery, and the trials will soon be resumed and vigorously prosecuted. They have already established the fact that the boat possesses merits of a high order, which will make it a useful adjunct to our submarine mines and an efficient weapon for repelling countermining operations and other attempts of the enemy to destroy channel obstructions.

The usual routine of laboratory and other trials to perfect the details of our system of submarine mining has been continued by Lieutenant Colonel Abbot, but his most pressing work has been the reduction and arrangement of the accumulated records for publication in the Battalion press. This is more than ever necessary now that officers of other arms of the service are allowed to take a course of instruction at Willets Point to qualify themselves for detail as acting engineers, should it become necessary to defend our coasts with submarine mines.

During the past year 126 quarto pages have been thus printed and are now in the hands of the Board, and it is believed that during the coming year the work will be brought up to date.

River and Harbor Improvements, &c.—Under this head the Board has, during the same period, prepared and forwarded reports upon the following projects submitted to it:

1880. August 23.—Upon project of Lieut. Col. G. K. Warren, for the improvement of Nantucket Harbor, Massachusetts.

August 25. Upon additional breakwater for the further improvement of Stonington Harbor, Connecticut.

September 10. Upon project of Col. George Thom, for the improvement of Rockland Harbor, Maine.

September 13. Upon project of Col. George Thom, for the improvement of the harbor of Scituate, Massachusetts.

September 16. Upon Lieutenant-Colonel N. Michler's modification of project for the improvement of South Shrewsbury River, New Jersey.

September 24. Upon project of Maj. S. M. Mansfield, for improvement of channel over bar at the mouth of Brazos River, Texas.

September 25. Upon project of Lieut. Col. N. Michler, for improvement of the channel between Staten Island and New Jersey.

September 30. Upon project of Capt. O. H. Ernst, for an ice-harbor at Saint Louis, Missouri.

October 4. Upon project of Col. George Thom, for the improvement of Newburyport Harbor, Massachusetts.

Nov. 16. Upon project of Charles Deering, for a breakwater at Rockland, Maine.

November 29. Upon plan of General H. Haupt, for the improvement of rivers; more especially the Ohio River.

November 30. Upon plan of Mr. H. F. Knapp, for improving the channel through Sandy Hook Bar, New York Harbor.

(See Appendix D 23.)

1881. January 13. Upon project of Maj. G. J. Lydecker, for an exterior breakwater at Chicago, Illinois.

February 12. Upon project of Capt. A. N. Damrell, for the improvement of Pensacola Harbor, Florida.

Upon the 16th of April a supplementary report upon the above subject was made.

February 12. Upon subject of improvement of the mouth of Columbia River, Oregon.

June 7. Upon subject of improvement of Christiana River, Delaware.

In addition to their duties with this Board the members have been engaged upon special boards and various duties, viz:

The special board for the improvement of Galveston Harbor, Texas, of which Generals Tower and Newton are members, was reconvened in October last to consider certain points presented to the Chief of Engineers by Colonel Mansfield, the officer in charge of this work of improvement. A report was submitted October 31. Subsequently Colonel Mansfield appeared before the Board, and on the 19th of November an addendum to prior report was forwarded, suggested by his explanations.

During the summer of 1880 General Tower made an examination of various harbors on the New England coast, and has in addition served upon a special board for the examination of candidates for promotion in the Corps of Engineers.

General Newton, besides attending to the important works of river and harbor improvement with which he is charged, has served during the past year as a member of the Warren Court of Inquiry.

General Abbot has continued in command of the Engineer school of application at Willets Point, L. I., and has served on a special board to examine engineer officers for promotion.

BOARD OF ENGINEERS FOR THE PACIFIC COAST.

This Board has consisted of the following officers of the Corps: Lieut. Col. C. S. Stewart, Lieut. Col. R. S. Williamson, Lieut. Col. G. H. Mendell, First Lieut. A. H. Payson, recorder, with whom in the discussion of certain of the subjects brought before it, have been associated Maj. Godfrey Weitzel, Maj. D. C. Houston, and Maj. G. L. Gillespie, of the Corps of Engineers.

The Board, during the year, has had under consideration, and has reported upon, the selection of a site for a harbor of refuge on the Pacific coast between San Francisco and the Straits of Fuca; on the canal at the Cascades of the Columbia River, Oregon, and on the occupation of one of the islands in the Bay of San Francisco, California, for a quarantine station.

BATTALION OF ENGINEERS AND SCHOOL OF APPLICATION.

The strength of the Battalion of Engineers on June 30, 1881, was 14 commissioned officers and 199 enlisted men.

It has been commanded during the year by Lieut. Col. Henry L. Abbot, and stationed as follows: The field, staff, band, and Companies A, B, and C at Willetts Point, New York Harbor; Company E at West Point, N. Y. Company D exists only on paper, at present, owing to the excessive reduction of the Battalion, in numerical strength, below the legal organization.

During the past year recruiting has been limited to the enlistment of suitable men, applying at Willets Point and West Point, and to occasional assignments of selected men from the general depot at David's Island.

The changes during the year have consisted of one death; 35 discharges; 9 desertions; 30 re-enlistments; 19 enlistments; 4 recruits received from depot; 1 deserter apprehended; and 3 transfers from other branches of service.

The military duties of the troops have consisted in guarding the depot at Willets Point, where over $3,000,000 worth of public property is intrusted to their care; performing skilled labor, such as remodeling the bridge trains, printing confidential documents pertaining to the torpedo service, and other work of a similar character. They also aid in the instruction of the Cadets at the Military Academy, in sapping, mining, and pontoniering. Their most important duty, however, is to keep pace with modern improvements in their special duties in time of war. These include many branches, such as military reconnaissance, the duplication of maps by photography, the practical details of submarine mining, the attack and defense of fortified positions, the construction of military bridges, the construction of land mines, &c., &c., which are unknown to other branches of the service, and in which rapid progress is now making by reason of the modern improvements in engines of war.

Such knowledge can only be obtained by constant study in times of peace, and its value at the outbreak of hostilities can hardly be overestimated.

The officers' branch of the school of application has made steady progress during the past year, and it now includes not only the strictly military parts of the profession, but also civil engineering to fit the young officers for the works of internal improvement upon which the Corps of Engineers is so largely engaged in times of peace. The course of instruction at West Point is, from the nature of the case, limited to the theoretical study of most of these branches; and the tour of duty at Willets Point not only accustoms the recent graduates to service with troops, but also renders them expert in the handling and use of instruments and in the practical application of their knowledge learned from books.

In connection with the submarine mining branch of the duties of the Corps of Engineers the young officers do much more than this. Every facility for the study of electricity and modern explosives is afforded them at Willets Point, and they acquire much information to be obtained at no other place in the country. During the past year the experiment of having a small detail of artillery officers study this course for a period of six months has been successfully tried. Three officers have done so in a thorough manner, and would now be qualified for detail as acting engineers should their services be required in defending our coasts with torpedoes.

In my last annual report I so fully set forth the necessity for an increase in the number of enlisted men of engineers that repetition here is hardly required. The matter is one of urgent importance, and I desire to press its consideration upon the attention of the department as strongly as possible. No change in the legal organization nor in the actual number of commissioned officers is requested; but only that the rank and file may be placed upon such a footing as to afford a reasonable expectation that the work which must devolve upon them at the outbreak of any war may be performed in a manner to meet the just expectations of the country. At present this is not the case, owing to the limitation fixed upon the number authorized to be enlisted—200 men instead of 752 men allowed by law.

(See Appendix No. 3.)

ENGINEER POST AND DEPOT AT WILLETS POINT, NEW YORK HARBOR.

This post and depot is commanded by Lieut. Col. Henry L. Abbot, Corps of Engineers.

It contains the engineer school of application, where the enlisted men of that branch of the service are trained in their duties as sappers, miners, pontoniers, military-map-making, &c., and where officers on assignment to the corps are sent for practical instruction in the military and in many of the civil branches of their profession. All our experiments with torpedoes have been conducted there, and from this school must come the officers and men qualified to employ the new weapon in defending our coasts against maritime attack.

The buildings have all been constructed in as plain and economical a manner as possible. No special appropriations have been made for several years for this purpose, and the sum of $5,000 is earnestly requested to continue the work.

The depot contains the bridge equipage of the Army, the engineer trains for field service, the torpedo materials stored for the defense of the coast, the astronomical, geodetic, and surveying instruments used by the corps in civil works, all guarded and cared for by the engineer troops.

The usual appropriation of $1,000 for the purchase of materials for instructing the three companies at Willets Point in their military duties is requested.

Also, the usual appropriation of $4,000 for the current expenses of the depot, including the repair of instruments for the general use of the orps.

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Statement of funds.

Amount expended and pledged, 1880–'81		$5,000
Amount available for 1881–'82		5,000
Amount desired for 1882–'83 viz:		
Materials for instruction of troops	$1,000	
Current expenses of depôt	4,000	
Construction of public buildings	5,000	
		10,000

(See Appendix No. 4.)

UNITED STATES MASTIC WORKS ON GOVERNOR'S ISLAND, NEW YORK HARBOR.

These works are in charge of Col. John Newton, Corps of Engineers.

Statement of mastic and bitumen stored with post quartermaster at Governor's Island, New York Harbor.

	Pounds.
Mastic:	
On hand July 1, 1880	236, 17
Sold to officers for public works	1,980
On hand July 1, 1881	234,187
Bitumen:	
On hand July, 1880	65,760
Sold to officers for public works	4,275
On hand July 1, 1881	61,485

RIVER AND HARBOR IMPROVEMENTS.

The funds with which the works for the improvement of rivers and harbors were prosecuted during the past fiscal year were derived from the balances of the appropriations of June 14, 1880, and of previous dates, together with such small portions of the appropriation of March 3, 1881, as were made available before the 30th of June.

A brief statement is given below, setting forth the condition of each improvement, the extent of the work performed during the year, the amount of money expended, and an estimate of the probable cost of completion, together with an estimate of the amount that can be profitably expended during the year ending June 30, 1883.

The reports of the officers in charge of the various improvements will be found in the Appendix, and to these reports special reference should be made whenever detailed information is desired concerning the progress and condition of each work.

The examinations and surveys required and provided for in the 3d section of the river and harbor act of March 3, 1881, have been distributed and assigned to the officers in charge of the several river and harbor districts, and it is expected that reports may be received in time to be submitted to Congress in the early part of the ensuing session.

ATLANTIC COAST.

IMPROVEMENT OF RIVERS AND HARBORS IN THE STATES OF MAINE, NEW HAMPSHIRE, AND MASSACHUSETTS.

Officer in charge, Col. George Thom, Corps of Engineers, who has under his immediate orders Lieut. William T. Rossell, Corps of Engineers.

1. *Breakwater on Saint Croix River, near Calais, Maine.*—This break-

water was built by the United States Government in 1856, upon "the Ledge," which is situated about 5 miles below the bridge at Calais, Me. It consists of three crib-work piers, ballasted with stone, and was so located as to prevent vessels in descending the river on the ebb-tide from being thrown upon the ledge by the strong tidal current which sets directly upon it. This work has hitherto answered this purpose in a very satisfactory manner, but, owing to the damage sustained by running ice and decay of timber, it has become so much dilapidated as to necessitate its being entirely *rebuilt.*

For this work the sum of $4,000 was appropriated by the river and harbor act of March 3, 1881, under which a contract has been made for its completion on or before the 31st of October, 1881.

Amount appropriated by act approved March 3, 1881	$4,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	24 59
July 1, 1881, amount available	3,975 41

(See Appendix A 1.)

2. *Lubec Channel, Maine.*—The project for the improvement of this channel was based upon a survey made in 1878, the object being to make the channel navigable in all stages of the tide by giving it a depth of not less than 12 feet at mean low-water, or 9 feet at low-water of spring tides. This channel is now obstructed by shoals lying between the head of "the Narrows" and "Western Bar beacon," a distance of about 2½ miles, the shoalest parts of which have a depth of not more than 5 feet at mean low-water.

The following appropriations have been made for this improvement, to wit:

By the river and harbor act of March 3, 1879	$44,000
By the river and harbor act of June 14, 1880	20,000
By the river and harbor act of March 3, 1881	45,000
Total	109,000

Under the appropriation of March 3, 1879, a contract was made in September, 1879, for the partial dredging of this channel. Under this contract the removal of the spit off Leadurny Point was completed and dredging was commenced in the lower part of the channel, near the "Western Bar beacon," after which (in March, 1880) the contracting party abandoned the work. Subsequently proposals were invited for this work three times, the last time August 17, 1880, under the two appropriations then available, resulting in a contract made September 2, 1880.

The total amount expended as above, to the close of the year ending June 30, 1880, was $3,127.35.

Under the contract of September 2, 1880, dredging was commenced June 1, 1881.

During the fiscal year ending June 30, 1881, the additional sum that has been expended, including outstanding liabilities, amounts to $3,663.50, whereby the channel has been still further improved at its lower end.

Under the appropriation of March 3, 1881, proposals are to be invited at an early day, for continuing this work.

With the amount now available the channel can probably be opened to the projected depth for a width of about 170 feet; but to complete it to the full projected width of 200 feet (as it should be), will require an additional appropriation of $25,000.

July 1, 1880, amount available	$60,872 65	
Amount appropriated by act approved March 3, 1881	45,000 00	
		$105,872 65
July 0, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	3,119 40	
July 1, 1881, outstanding liabilities	544 10	
		3,663 50
July 1, 1881, amount available		102,209 15
Amount (estimated) required for completion of existing project		25,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		20,000 00

(See Appendix A 2.)

3. *Moose-a-bec Bar at Jonesport, Maine.*—The project for the improvement of the channel at this place was adopted in 1881, the object being to afford a safe and direct channel of not less than 200 feet in width and 14 feet in depth at mean low-water, or 11¾ feet at low-water of spring-tides, the mean fall of the tides being 11½ feet. The main channel is very narrow and tortuous, and so much obstructed by sunken ledges as to make navigation very unsafe.

The estimated cost of this improvement is $35,000.

By the river and harbor act of March 3, 1881, there was appropriated therefor the sum of $10,000, which is to be applied to the partial dredging of the channel across the bar, the same to be done by contract.

The additional amount of $25,000 that will be required for the completion of this improvement, it is proposed to apply to the completion of this channel to the projected width and depth, and to the removal of the sunken ledge near steamboat buoy.

Amount appropriated by act approved March 3, 1881	$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	8 75
July 1, 1881, amount available	9,991 25
Amount (estimated) required for completion of existing project	25,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	25,000 00

(See Appendix A 3.)

4. *Belfast Harbor, Maine.*—The project for the improvement of this harbor was adopted in 1876, the object being to give a depth in front of the wharves sufficient to enable steamers and other vessels to arrive and depart in all stages of the tide. In the upper part of the harbor, in front of Lane's wharf, there was not more than 4 feet of water at mean low-water, when surveyed in 1875, and this depth increased downwards to about midway between Sanford's Boston steamer wharf and McGilvery's ship-yard, where there was 12 feet of water at mean low-water.

Under the several appropriations, aggregating $22,000, made in the years 1876–'79, this harbor has been excavated to a depth of 10 to 12 feet at mean low-water from the wharf lines out to deep water, in completion of the project adopted.

July 1, 1880, amount available	$3,000 00
July 1, 1881, amount available	3,000 00

(See Appendix A 4.)

5. *Rockland Harbor, Maine.*—The project for the improvement of this harbor was adopted in January, 1881, the object being to afford a safe and convenient harbor of refuge at this place, by means of two rubble stone breakwaters, one to be built out from Jameson Point, in a direction of

about south, 16½° east for a distance of 1,900 feet from high-water mark, and the other to commence at South Ledge, and extend in a direction about north, 9° east for a distance of 2,640 feet.

The estimated cost of these breakwaters is as follows, viz:

Jameson Point Breakwater	$125,000
South Ledge Breakwater	375,000

By the river and harbor act of June 14, 1880, the sum of $20,000 was appropriated for this harbor, under which a contract has been made for furnishing and placing in the Jameson Point breakwater 24,000 tons of rubble stone, the contract to be completed on the 30th of November, 1881.

The amount expended during the fiscal year ending June 30, 1881, including outstanding liabilities is $10,823.92 whereby the breakwater has been built out for a length of 560 feet to a point distant about 670 feet from high-water mark; with a probability of its completion to a farther distance of about 400 feet under the present contract.

The appropriation of $105,000 asked for, for the fiscal year ending June 30, 1883, it is proposed to apply to the completion of the Point breakwater.

July 1, 1880, amount available		$20,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$9,854 99	
July 1, 1881, outstanding liabilities	968 93	
		10,823 92
July 2, 1881, amount available		9,176 08
Amount (estimated) required for completion of existing project		480,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		105,000 00

(See Appendix A 5.)

6. *Richmond Harbor, Kennebec River, Maine.*—The project for the improvement of this harbor was adopted in 1881, the object being to afford a channel of navigable width and of not less than 10 feet in depth at mean low-water at the shoals at the upper end of Swan Island, and at Hatch's Rocks, 2 miles below; and not less than 11 feet at mean low-water at the foot of Swan Island. The channel at the first two places is narrow and not more than 8¼ feet in depth at mean low-water, whilst at the foot of the Island it is not more than 30 feet in width for a depth of 11 feet at mean low-water.

By the river and harbor act of March 3, 1881, the sum of $10,000 was appropriated for the improvement of this harbor, which is to be applied to the construction of a wing-dam at the head of Swan Island, and to the dredging in part, of the projected channels at Hatch's Rocks Shoal, and at the foot of Swan Island, for which works contracts have been made. The additional appropriation of $10,000 asked for is to be applied to completing the dredging of the channels and the wing dam at Hatch's Rocks Shoal.

Amount appropriated by act approved March 3, 1881	$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	19 02
July 1, 1881, amount available	9,980 98
Amount (estimated) required for completion of existing project	10,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	10,000 00

(See Appendix A 6.)

7. *Cathance River, Maine.*—The project for the improvement of this river was based upon the survey made in 1879, the object being to afford a channel of navigable width and of not less than 10 feet depth at mean low-water (or 15½ feet at mean high-water) from the outlet of the river into Merrymeeting Bay to the channel of Kennebec River near "The Chops," a distance of about 2⅛ miles. The natural channel was crooked and had but 6 feet of water at mean low-water in its shoalest part.

By the river and harbor act of June 14, 1880, the sum of $10,000 was appropriated for the improvement of this river, of which there was expended during the fiscal year ending June 30, 1881, the sum of $9,459.69, which was applied to the completion of the channel by dredging through the "outer bar" (near "The Chops"), and to its completion at the lower part of the Bar III, for a width of 100 feet.

By the river and harbor act of March 3, 1881, the additional sum of $6,000 was appropriated for this river, under which a contract has been made for completing the work that is now deemed most necessary for its improvement, and is to be applied to widening the channel at the lower part of Bar III to a width of about 130 feet, and to opening a channel to a width of about 125 feet through the upper part of this bar, the same to be completed on or before the 30th of September, 1881.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	6,000 00	
		$16,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		9,459 69
July 1, 1881, amount available		6,540 31
Amount (estimated) required for completion of existing project		9,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		9,000 00

(See Appendix A 7.)

8. "*Gut*" *opposite Bath, Maine.*—The project for the improvement of the channel at this place was adopted in 1870 and modified in 1878, the object being to afford a navigable channel not less than 90 feet in width at and near "upper hell-gate," in Back River, and of not less than 11 feet in depth at mean low-water above the gate, and 12 feet in depth below it. The channel was originally very crooked and narrow, and much obstructed by dangerous sunken ledges, the shoalest of which had not more than 3 feet of water on it at mean low-water.

The total amount expended to the 30th of June, 1880, on the project now being executed was $33,249.71, whereby the channel above the gate had been opened to the projected width (110 feet) and depth, and in the gate and below it to a depth of 12 feet at mean low-water for a part of its extent only.

Under the appropriation of $7,000 made by the river and harbor act of June 14, 1880, a contract was made for breaking up and removing about 175 cubic yards of the remaining sunken ledges, the same to be completed during the present season.

During the year ending June 30, 1881, there has been expended, including outstanding indebtedness, the sum of $1,901.37 in partial completion of said contract.

Under the appropriation of $5,000 made by the river and harbor act of March 3, 1881, a contract has been made for breaking up and removing all the remaining sunken ledges in completion of all the work projected for the improvement of this channel, the same to be completed on or before the 30th of November, 1881.

July 1, 1880, amount available	$7,250 29	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$12,250 29
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,551 37	
July 1, 1881, outstanding liabilities	350 00	
		1,901 37
July 1, 1881, amount available		10,348 92

(See Appendix A 8.)

9. *Portland Harbor, Maine.*—The project for the improvement of this harbor by building a breakwater on Stanford's Ledge was adopted in 1833–'36, and was modified in 1866, 1872 and 1881 as to the plan for the completion of the breakwater and the improvement of the harbor by dredging. The amount expended thereon up to the close of the fiscal year ending June 30, 1880, was $250,000, by which the following work had been done, to wit:

1. The breakwater extended and completed for a total length of 2,005 feet, including the granite pier, 25 feet in diameter, at its outer extremity.
2. A channel dredged through the Middle Ground Bar to a width of 500 feet and to a depth of 20 to 22 feet at mean low-water, on the shoalest part of which there was originally but 15 feet at mean low-water.
3. The area in front of the Grand Trunk Railway wharves dredged to a depth of 20 feet at mean low-water, and all that in front of the Harbor Commissioner's Line, from Atlantic Wharf up to Merrill's Wharf, to a depth of 16 feet, where before, on its shoalest part, there was but 4 feet of water at mean low-water.
4. The channel in Back Bay, from Tukey's Bridge up to the stone-shed wharves, dredged to a width of not less than 100 feet and for a depth of 8 feet, where before, on its shoalest part, there was but 2 feet of water at mean low-water.
5. Sunken rocks and a wreck removed from the harbor.

During the fiscal year ending June 30, 1881, the additional sum of $13,299.31 has been expended, whereby the dredging in front of the Harbor Commissioner's Line has been continued to a depth of 16 feet at mean low-water up to near Brown's wharf, and in front of Atlantic Wharf to a depth of 21 feet at mean low-water, and the removal of the "Middle Ground," in the lower part of the harbor to a depth of 21 feet at mean low-water, has been commenced.

There is now available for this harbor $46,700.69 which is to be applied under a contract therefor, to continuing the removal of the "Middle Ground" to a depth of 21 feet at mean low-water, for a width of about 400 feet which will probably be completed before the close of the present season.

The amount that can be profitably expended during the fiscal year ending June 30, 1883, is $110,000 which, if appropriated, it is proposed to apply to completing the removal of the "Middle Ground" to a depth of 21 feet at mean low-water, up to the Harbor Commissioner's Line, being all that is now projected for completing the improvement of this harbor.

By the removal of this "Middle Ground," as projected, greatly increased facilities which have now become necessary, would be afforded the numerous ocean steamers as well as other large class vessels which visit this port, in approaching and entering the present and projected docks, as well as in affording more capacious and suitable anchorage ground.

July 1, 1880, amount available	$40,000 00	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$60,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	12,967 50	
July 1, 1881, outstanding liabilities	331 81	
		13,299 31
July 1, 1881, amount available		46,700 69
Amount (estimated) required for completion of existing project		110,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		110,000 00

(See Appendix A 9.)

10. *Richmond's Island Harbor, Maine.*—The project adopted for the improvement of this harbor was adopted in 1872, the object being to afford a harbor of refuge by means of a rubble stone breakwater about 2,000 feet in length which connects the island with the main land.

The total amount expended thereon up to the close of the fiscal year ending June 30, 1881, was $106,907.18, whereby the breakwater has been built to the projected length nearly in completion of same.

The amount now available is to be applied under a contract made therefor, to the completion of this work to the projected height, so that no further appropriation is asked therefor.

July 1, 1880, amount available	$3,000 00	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$6,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,907 18
July 1, 1881, amount available		3,092 82

(See Appendix A 10.)

11. *Kennebunk River, Maine.*—The project originally adopted for the improvement of this river, consisted in the erection, in 1829–'52, of two granite piers at its mouth, to afford a permanent entrance to the river, and of a wharf a short distance above for the security of vessels when detained by tides and storms. With the appropriations made in 1870 and 1871, aggregating $10,000, these piers were extended and repaired and the wharf above was also repaired. This project was modified in 1876, the object being to afford a channel of navigable width from the mouth of the river up to Kennebunkport, a distance of about 1 mile, and of not less than 4 feet in depth at mean low-water, or 13 feet at mean high-water.

The amount expended from 1870 to June 30, 1880, is $15,074.83, and has resulted, in addition to the extension and repairs of the piers and wharf, in the partial improvement of the channel as projected.

During the fiscal year ending June 30, 1881, the sum of $3,929.81 was expended on this work, which has resulted in the completion of the channel as projected, and in some repairs on the Government Wharf. The amount now available is to be applied to completing the repairs of the wharf and piers, which will be sufficient for that purpose, so that no further appropriation is required for this river.

July 1, 1880, amount available	$3,925 17	
Amount appropriated by act approved March 3, 1881	2,000 00	
		$5,925 17
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		3,929 81
July 1, 1881, amount available		1,995 36

(See Appendix A 11.)

12. *Winnipiseogee Lake, New Hampshire.*—The project for the improvement of this lake was adopted in 1879, the object being to afford at its outlet into Long Bay, a channel 50 feet in width and not less than 5 feet in depth in the lowest known stage of the water, the estimated cost of which was $7,500.

For completing this improvement the following sums have been appropriated by Congress, viz:

By the river and harbor act of June 14, 1880	$5,000
By the river and harbor act of March 3, 1881	2,500
Total	7,500

Under these appropriations contracts have been made for the completion of the proposed improvement, on or before the close of the present season, some progress having been made thereon during the fiscal year ending June 30, 1881.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	2,500 00	
		$7,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		104 35
July 1, 1881, amount available		7,395 65

(See Appendix A 12.)

13. *Lamprey River, New Hampshire.*—The project for the improvement of this river was adopted in 1874, the object being to afford a channel of navigable width and not less than 11 feet in depth at mean high-water from its mouth to the head of tide-water at New Market, a distance of about 2½ miles.

The natural channel is, in places, narrow and crooked, and much obstructed by sunken rocks and shoals, with not more than 9 feet of water upon them at mean high-water.

By the river and harbor act of March 3, 1881, the sum of $10,000 was appropriated for the improvement of this river, which is to be applied to the removal, in part, of the sunken rocks, arrangements having been made to commence operations at once.

Should the sum of $14,000 asked for, for the fiscal year ending June 30, 1883, be appropriated, it is proposed to apply it to completing the removal of all the shoals and obstructions estimated for in the original project, whereby a safe, navigable channel will be made up to the head of navigation at the wharves of New Market.

Amount appropriated by act approved March 3, 1881	$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	8 75
July 1, 1881, amount available	9,991 25
Amount (estimated) required for completion of existing project	14,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	14,000 00

(See Appendix A 13.)

14. *Exeter River, New Hampshire.*—The project for the improvement of this river was adopted in 1880, the object being to afford a channel of navigable width from the mouth of the river up to the head of tide-water at Exeter, N. H., and of not less than 10 to 12 feet in depth at mean

high-water. The natural channel is narrow and crooked and obstructed by sunken rocks, and in its shoalest part in Exeter it has not more than 7½ feet of water at mean high-water.

The following appropriations have been made by Congress for completing all the work projected for the improvement of this river, to wit:

By the river and harbor act of June 14, 1880	$20,000
By the river and harbor act of March 3, 1881	15,000
Total	35,000

The amount expended thereon during the fiscal year ending June 30, 1881 (including outstanding liabilities), is $3,026.92, which has resulted in the removal of nearly all the sunken rocks from the channel whereby its navigation has been very much improved throughout. A contract has also been made for completing all the projected dredging during the present season, of which a portion has been done above Fernald's wharf, so that no further appropriation will be required therefor.

July 1, 1880, amount available	$20,000 00	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$35,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,072 92	
July 1, 1881, outstanding liabilities	954 00	
		3,026 92
July 1, 1881, amount available		31,973 08

(See appendix A 14.)

15. *Portsmouth Harbor, New Hampshire.*—The project for the improvement of this harbor was adopted in 1879, the object being:

1. To close by means of a rubble-stone breakwater the channel between Great Island and Goat Island, so as to prevent the strong current of flood-tide from passing through that channel, as by it vessels in going up the harbor have often been thrown upon Goat Island Ledge, which projects far into the channel, here very narrow.

2. The removal of Gangway Rock to a depth of 20 feet at mean low-water, or 28½ feet at mean high-water, which lies in the channel between South Beacon Shoal and the navy-yard, the shoalest part of which has now but 12 feet of water on it at mean low-water, and 9.7 feet at extreme low-water of spring tides.

3. The removal, in part, of the ledge at the southwestern point of Badger's Island, upon which vessels are liable to be, and often have been, thrown, in coming down the harbor on the ebb-tide.

The total amount expended to June 30, 1880, on the project being executed is $9,988.54, which resulted in nearly completing the breakwater between Great Island and Goat Island.

The amount expended (including outstanding indebtedness), during the fiscal year ending June 30, 1881, is $4,601.61, which has resulted in the completion of the breakwater between Great Island and Goat Island and in the removal, in part, of Gangway Rock.

The amount now available for this harbor is to be applied to the removal, in part, of Gangway Rock under contracts made and to be made therefor.

The amount of $55,000, if appropriated, can be profitably expended during the fiscal year ending June 30, 1883, in the completion of the removal of Gangway Rock to the depth projected.

July 1, 1880, amount available	$25,011 46	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$45,011 46
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,322 61	
July 1, 1881, outstanding liabilities	279 00	
		4,601 61
July 1, 1881, amount available		40,409 85
Amount (estimated) required for completion of existing project		95,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		55,000 00

(See Appendix A 15.)

16. *Newburyport Harbor, Massachusetts.*—The project for the improvement of this harbor (at its entrance) was adopted in 1880, after a special survey, the object being to make a permanent channel of sufficient width and depth to enable vessels drawing 13 feet of water to enter it in safety at all times of tides and storms. The project consists of two converging rubble-stone jetties built out from the shores north and south of the entrance (the northern with a length of 2,910 feet and the southern of 1,500 feet), so as to have between their outer ends an entrance about 1,000 feet in width and not less than 17 feet in depth at mean low-water, or 24½ feet at mean high-water.

The present estimated cost of the northern jetty is	$250,000
And of the southern jetty	115,000
Total	365,000

Under the appropriations made therefor by the river and harbor acts of June 14, 1880, and March 3, 1881, aggregating $90,000, a contract has been made for furnishing and placing in the northern jetty, at and near its shore end, 60,000 tons, more or less, of rubble-stone at $1.32 per ton of 2,240 pounds, the contract to be completed in June, 1882.

During the fiscal year ending June 30, 1883, the sum of $100,000 could be profitably expended on the northern jetty.

July 1, 1880, amount available	$50,000 00	
Amount appropriated by act approved March 3, 1881	40,000 00	
		$90,000 00
July 1, 1881 amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,585 82
July 1, 1881 amount available		87,414 18
Amount (estimated) required for completion of existing project		275,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		100,000 00

(See Appendix A 16.)

17. *Merrimac River, Massachusetts.*—The present project for the improvement of this river was adopted in 1870, and modified in 1874; the object being to afford a channel of navigable width, with a depth of not less than 9 feet at mean low-water (or about 16½ feet mean high-water) from its mouth at the outlet of Newburyport Harbor up to Deer Island Bridge, a distance of about 5 miles; and thence up to Haverhill Bridge (an additional distance of 12½ miles), a depth of 12 feet at ordinary *high*-water, the rise and fall of tides varying from 7½ feet to 4 feet; and thence up to the head of the "Upper Falls" (an additional distance of 4 miles), a depth of not less than 4½ feet in the ordinary stages of the river with the mill-water at Lawrence running; the rise and fall of the tide varying from 4 feet at Haverhill to 0 at the foot of the "Upper Falls."

The natural channel of this river was very narrow and crooked in several places, and much obstructed by sunken ledges, bowlders, and shoals; and especially at "the falls," portions of which were covered with bowlders and ledges more or less bare, and impassable for any vessels or scows; whilst in Newburyport Harbor the channel was obstructed by numerous sunken ledges, crib-work piers and wrecks, seriously endangering navigation.

The amount expended for the improvement of this river up to the 30th of June, 1880, was $132,557.95, and the work done for its improvement consisted in opening the channel above Haverhill and through "the falls" to the projected width and depth, in places where absolutely necessary to make its navigation practicable; also, in dredging at Haverhill between the bridges, and at Silsby's Island Shoals, as well as at Currier's Shoal (about 4 miles below Haverhill), and at Rock's Bridge (6¾ miles below Haverhill), including the removal of a large number of dangerous sunken rocks at and near Rock's Bridge and the head of Silsby's Island; also, in Newburyport Harbor in the partial removal of Gangway Rock and North Rocks, and in the removal of a sunken wreck.

During the fiscal year ending June 30, 1881, the sum of $15,469.52 has been expended in the improvement of this river, and has resulted in obtaining a channel of increased width and depth at "the falls" above Haverhill, and near Rock's Bridge, by dredging and by removing sunken rocks; also, in the removal of numerous sunken crib-work piers and ledges, and a wreck in the harbor of Newburyport, which have hitherto greatly endangered navigation.

The amount of $18,000, if appropriated, could be profitably expended in the removal of all the remaining sunken rocks and ledges in Newburyport Harbor, at Rock's Bridge, and in "the falls" above Haverhill, in completion of all the work now projected for the improvement of this river.

July 1, 1880, amount available	$15,442 05	
Amount appropriated by act approved March 3, 1881	$ 9,000 00	
		$24,442 05
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		15,469 52
July 1, 1881, amount available		8,972 53
Amount (estimated) required for completion of existing project		18,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		18,000 00

(See Appendix A 17.)

18. *Boston Harbor, Massachusetts.*—In 1866 a project was adopted for the improvement of this harbor, which has since been executed and modified as the interests of the harbor demanded. The objects of the improvement have been and are:

1. The preservation and protection by permanent sea-walls of all the principal headlands, which were being rapidly worn away by tides and storms, not only to the serious detriment of the channel, but also to that of navigation in the loss of guide-marks for sailing directions.

2. Widening, straightening, and deepening the main ship-channel by dredging and the removal of dangerous sunken rocks, so as to have a channel of not less than 600 feet in width and 23 feet in depth at mean low-water, and the removal of the sunken rocks and shoals in other parts of the harbor and in Broad Sound.

3. Widening and deepening the channel in Hingham Harbor by dredging and removing sunken ledges to a width of not less than 100

feet and a depth of 8 feet at mean low-water, in the shoalest part of which there was not more than 3 to 5 feet of water at mean low-water.

4. Opening a channel at the mouth of Mystic River, in the upper harbor, to a width of 300 feet and a depth of 23 feet at mean low-water, in the shoalest part of which there was before not more than 16 feet at mean low-water.

5. Opening a navigable channel from the mouth of Charles River, in the upper harbor, up to the head of tide-water at Watertown.

6. Improving the channel leading from the harbor to Nantasket Beach, so as to have for a width of not less than 100 feet a depth of 9½ feet at mean low-water.

The total amount expended to June 30, 1880, on the projects executed since 1866, was $1,257,565.08, by which the following work has been done:

Sea-walls built at Point Allerton, Great Brewster Island, Lovell's Island (north and southeast heads), Gallop's Island, and Long Island (north head), and those on Deer Island repaired.

Sunken rocks broken up and removed, including Kelly's Rock and all the known ledges near it, Tower Rock, Corwin Rock, the ledges recently discovered at the west end of Great Brewster Spit and between there and George's Island, all in the main ship-channel at "the Narrows," to a depth of 23 feet at mean low-water; also to the same depth the sunken ledges and bowlders recently discovered in the main ship-channel at the Upper Middle; also Barrel Rock, in Broad Sound, and State and Palmyra rocks at the Lower Middle.

Dredging in the main ship-channel at the west end of Great Brewster Spit, at the southeast and southwest points of Lovell's Island, and "Cape Cod Shoal," at the Upper Middle, and Man-of-War Shoals, in completion of the same; some progress made in the projected dredging at Anchorage, Lower Middle, and Mystic River shoals; and the improvements in Hingham Harbor and at Nash's Rock Shoal completed.

The locations of all these improvements are shown on the sketch of Boston Harbor which accompanied the last annual report.

During the fiscal year ending June 30, 1881, the sum of $61,461.70 (including outstanding liabilities) was expended for the improvement of this harbor, whereby the channel at Anchorage Shoal has been opened for an additional width of 110 feet, making a total width of 660 feet for a depth of 23 feet at mean low-water, and the channel at Mystic River for an additional average width of not less than 125 feet, making a total average width of about 250 feet, for a depth of 23 feet at mean low-water; and the channel of Charles River near its mouth (below Brookline Bridge) has been opened to a depth of 7 feet at mean low-water, and for a width of 200 feet for a length of about 2,600 feet; and the channel leading to Nantasket Beach for a width of about 70 feet and to a depth of 9½ feet at mean low-water; the mean rise and fall of the tides in all these places being about 10 feet.

Under the appropriation of $100,000 made by the river and harbor act of March 3, 1881, contracts have been made for completing the Mystic River channel and the Charles River channel as far up as Market street Bridge; and contracts are to be made for completing all the dredging projected for Anchorage Shoal, and, in part, that for the Nantasket Beach channels.

Should the sum of $96,500 asked for be appropriated for the fiscal year ending June 30, 1883, it is proposed to apply it to the completion of the improvement of the channel of Charles River up to Watertown, and of the Nantasket Beach channel, as well as all the work now contemplated for the improvement of Boston Harbor, no further appropriation being required for the Mystic River channel.

July 1, 1880, amount available	$91,698 92	
Amount appropriated by act approved March 3, 1881	100,000 00	
		$191,698 92
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	57,014 03	
July 1, 1881, outstanding liabilities	4,447 67	
		61,461 70
July 1, 1881, amount available		130,237 22

Amount (estimated) required for completion of existing project	$96,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	96,500 00

(See Appendix A 18.)

19. *Scituate Harbor, Massachusetts.*—The project for the improvement of this harbor was adopted in 1880, the object being to make a harbor of refuge for vessels caught in easterly storms off this coast when unable to find shelter elsewhere. The project consists of—

1. Building of two breakwaters out from the projecting points at the entrance to this harbor—that from Cedar Point on the north side for a length of 800 feet, and that from First Cliffs on the south side for a distance of 730 feet—to be located (as shown on the accompanying sketch) so as to protect the harbor from all winds from the eastward; and,
2. Dredging the harbor inside the breakwaters, as well as the channel leading up to it, to depths varying from 10 to 15 feet at mean low-water, the mean rise and fall of the tides being 10 feet.

The estimated cost of this improvement is as follows, to wit:

1. For the northern breakwater	$44,000
2. For the southern breakwater	46,000
3. For dredging the harbor	190,000
Total	280,000

By the river and harbor acts of June 14, 1880, and March 3, 1881, the aggregate sum of $17,500 was appropriated for this harbor, under which a contract has been made for 10,000 tons of rubble-stone to be placed in the northern breakwater.

The officer in charge asks that the sum of $100,000 be appropriated for the fiscal year ending June 30, 1883, and proposes to apply it to the partial completion of the two breakwaters, and to opening an entrance channel between them into the inner harbor. This sum is reduced to $30,000 in this office.

July 1, 1880, amount available	$7,500 00	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$17,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		220 06
July 1, 1881, amount available		17,279 94

Amount (estimated) required for completion of existing project	262,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	30,000 00

(See Appendix A 19.)

20. *Plymouth Harbor, Massachusetts.*—The present project for the improvement of this harbor was adopted in 1866 and modified in 1875, the object being—

1. The protection and preservation of Long Beach upon the existence

of which the harbor depends for its only shelter from easterly storms; and

2. Opening a channel 100 feet in width and of not less than 6 feet in depth at mean low-water (or 16 feet at mean high-water) from the Middle Ground up to Long Wharf, and thence to the mouth of Town Brook, 150 feet in width with a depth of 8 feet at mean low-water. The natural channel was very narrow and crooked with not more than ½ foot in depth at mean low-water in its shoalest part.

The total amount expended from 1866 to the 30th of June, 1880, on the project being executed was $61,271.15, and resulted in the completion of the works projected for the protection and preservation of Long Beach, and in a channel 50 feet in width from the Middle Ground up to Long Wharf.

The amount expended thereon during the fiscal year ending June 30, 1881, including outstanding liabilities, is $8,609.15, which has resulted in the completion of the main channel leading from the Middle Ground up to the wharves of Plymouth, to its full width of 100 feet, and in the commencement of the 8-foot channel in front of the wharves.

Under the appropriation of $10,000 made by the river and harbor act of March 3, 1881, a contract has been made for completing on the 31st of January, 1882, all the work projected for the improvement of this harbor.

The sum of $1,000 asked for, for the fiscal year ending June 30, 1883, it is proposed to apply, if appropriated, to such repairs as may be required on the several works built for the protection and preservation of Long Beach.

July 1, 1880, amount available	$13,528 85	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$23,528 85
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	7,114 83	
July 1, 1881, outstanding liabilities	1,494 32	
		8,609 15
July 1, 1881, amount available		14,919 70
Amount (estimated) required for completion of existing project		1,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		1,000 00

(See Appendix A 20.)

21. *Provincetown Harbor, Massachusetts.*—The present project for the improvement of this harbor was adopted in 1866, the object being the protection and preservation of Long Point and Beach Point and the beach at Cove Section, and closing the side channels at the head of Lancey's Harbor, and at East Harbor Creek (at the Wading-place), near High Head.

The amount expended to June 30, 1880, on the project being executed, was $100,455.67, and resulted in the completion of all the bulkheads, jetties, and dikes projected for the above localities, with the exception of the stone bulkhead on Long Point. All those works are generally in excellent condition and have fully answered the purpose for which they were designed.

During the fiscal year ending June 30, 1881, the sum of $1,125.68 has been expended in raising and strengthening the stone bulkhead on Long Point where most necessary.

By the river and harbor act of March 3, 1881, the sum of $5,000 was appropriated, which is to be applied to the extension of the stone bulkhead on Long Point.

The additional $5,000 asked for, for the fiscal year ending June 30, 1883, it is proposed to apply, if appropriated, to the *completion* of that bulkhead.

July 1, 1880, amount available	$1,112 77	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$6,112 77
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		1,125 68
July 1, 1881, amount available		4,987 09
Amount (estimated) required for completion of existing project		5,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		5,000 00

(See Appendix A 21.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with provisions of the river and harbor act of June 14, 1880, Colonel Thom was charged with and has completed the following, which were transmitted to Congress and printed in Senate Ex. Doc. No. 29, Forty-sixth Congress, third session:

1. *Malden River, Massachusetts.* (See Appendix A 22.)
2. *For improving Richmond Harbor, on the Kennebec River, Maine.* (See Appendix A 6.)
3. *Mouth of Narraguagus River, at Milbridge, Maine.* (See Appendix A 23.)

And to comply with the provisions of the river and harbor act of March 3, 1881, he has been charged with and is now engaged upon surveys and examinations at the following localities, the results of which will be duly submitted when received:

1. *To deepen the channel of the Harrisecket River from Weston's Point to Freeport Landing, in Freeport, Maine.*
2. *Harbor of Brunswick, on the Androscoggin River.*
3. *Lynn Harbor, Massachusetts.*
4. *Merrimac River, from Lawrence, Massachusetts, to Manchester, New Hampshire.*

IMPROVEMENT OF HARBORS AND RIVERS ON THE SOUTHERN COAST OF MASSACHUSETTS AND IN RHODE ISLAND—IMPROVEMENT OF CONNECTICUT RIVER.

Officer in charge, Lieut. Col. G. K. Warren, Corps of Engineers.

1. *Hyannis Harbor, Massachusetts.*—This harbor is on the northern shore of Nantucket Sound, and is sheltered by a breakwater 1,170 feet long. It has a depth of from 9 to 20 feet at mean low-water and an area of about 175 acres. The mean rise and fall of the tide is about 3.8 feet. It is accessible to vessels drawing 16 feet at time of mean low-water. The breakwater was built in 1828–1837, at a cost of $70,931.82. In 1853 the sum of $5,000 was spent in repairs. Although the breakwater has sustained injuries, it has always afforded effective shelter.

In 1870 repairs were again made on it, and between that time and June 30, 1880, $42,500 have been expended in building up the foundation of the work and in removing a wreck.

No money was appropriated or expended during the year ending June 30, 1881.

The river and harbor act of March 3, 1881, appropriated $5,000, which will be expended in completing the repairs to the breakwater, in accordance with the approved project of 1874.

No further appropriation is required to complete the repairs.

Hyannis is a place of summer resort. A branch of the Old Colony Railroad, from Boston, terminates here. Considerable coal for Cape Cod is landed here. The harbor's chief importance is to general commerce as a harbor of refuge. The number of vessels seeking shelter here in 1878 was about 1,400.

Hyannis Harbor is in the Barnstable collection district; that place is the nearest port of entry; the amount of revenue collected there during the fiscal year ending June 30, 1881, is not known at this office.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	50 62
July 1, 1881, amount available	4,949 38

(See Appendix B 1.)

2. *Nantucket Harbor, Massachusetts.*—Nantucket Harbor is on the north side of the island of Nantucket. The depth in the harbor exceeds 12 feet at mean low-water, with a mean rise of tide of about 3 feet.

The shoal across the entrance has a ruling depth of about 6 feet at mean low-water. This shoal is about 1¼ miles in width at the entrance and extends for several miles along the shore each way. The channel across it, or line of best water, is very crooked and frequently changes in direction, but its limiting depths seem to have been about the same as far back as we have any record of it.

In 1829 a project for dredging a channel through the shoal across the entrance was adopted, and in the years 1829, 1831, and 1832 $44,265 was expended in carrying it out. No permanent improvement resulted from this expenditure. The dredged channel was nearly obliterated by one storm.

The present approved and adopted project consists in extending riprap jetties from the shore across the bar to deep water outside. The jetty on the west side is to be built first, the other one to be built as developments show its necessity. The first appropriation was $50,000, made June 14, 1880.

The work during the fiscal year just ended has only set the improvement going, and it has not been carried far enough to produce any effect.

During the fiscal year ending June 30, 1882, it is expected that all the money available will be expended, but no material benefits are expected to result in this incomplete state of the work. These will not be realized until the whole is complete.

It is believed that the mean low-water depth at the entrance can be ultimately increased to 12 feet. In this condition it will be an available harbor of refuge for vessels in distress navigating the contiguous dangerous waters. Any increase of depth with permanent establishment of channel will aid the communication with Nantucket Island, which is becoming an important summer resort.

Nantucket is a port of entry and the center of a collection district, but "no transactions" relating to revenue are reported for the fiscal year ending June 30, 1881.

July 1, 1880, amount available	$50,000 00	
Amount appropriated by act approved March 3, 1881	25,000 00	
		$75,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	7,551 91	
July 1, 1881, outstanding liabilities	363 37	
		7,915 28
July 1, 1881, amount available		67,084 72
Amount (estimated) required for completion of existing project		149,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		75,000 00

(See Appendix B 2.)

3. *Wood's Holl Harbor, Massachusetts.*—The name Wood's Holl is here applied to the strait connecting the waters of Buzzard's Bay and Vineyard Sound. It is badly obstructed by rocks and is subject to very strong currents, making dangerous navigation.

Estimates for several improvements were submitted in 1873, varying in cost between $5,000 and $446,000.

In 1878 an appropriation of $15,000 was made for clearing the strait of the rocks most in the way of existing steamboat navigation and for deepening the entrance to Little Harbor.

The amount expended up to June 30, 1880, was $13,378, of which about $4,000 was expended in deepening the entrance to Little Wood's Holl Harbor to 10 feet at mean low-water for a width of 130 feet. The mean rise of the tide is 1.65 feet in Little Harbor. This latter work was mainly for the light-house depot located there, and it enabled light-ships to enter. The work done in the strait relieved the navigation through it of its worst obstructions.

The amount expended during the year ending June 30, 1881, completed the removal of the rocks in the strait, which the existing steamboat lines desired removed, and the navigation is now regarded by their managers as safe, so that this partial project is complete.

No additional appropriation is asked for.

To complete the entire improvement would still require $430,000, which would then make it available for the largest coasting vessels. This is not pressing at the present time.

A detailed report of tidal observations accompanies the report of the engineer in charge.

The benefits accomplished are the facilitating of the working of the Light House Service and rendering safe the transport of passengers between the main land and the islands of Nantucket and Martha's Vineyard.

Wood's Holl is in the Barnstable collection district. New Bedford is the nearest port of entry. The amount of revenue collected at New Bedford in the fiscal year ending June 30, 1881, was $23,806.42. The amount of revenue collected in the Barnstable collection district during the fiscal year ending June 30, 1881, is not known at this office.

July 1, 1880, amount available	$1,622 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	716 26
July 1, 1881, amount available	905 74

(See Appendix B 3.)

4. *Wareham Harbor, Massachusetts.*—This harbor is an estuary of Buzzard's Bay. It is about 13 miles east of the harbor of New Bedford. It is from 200 feet in width in the upper part to more than one-half mile in width in the lower part, and is separated from Buzzard's Bay by Long Beach, with a channel 500 feet wide to the west of it.

Before any improvement was made, the ruling depth in the harbor was about 7 feet at mean low-water in a narrow and very crooked channel. The mean rise of the tide is 4 feet.

The original project adopted in 1871 was to straighten the channel, widen it to 100 feet in the upper and to 300 feet in the lower part, and deepen it to 9 feet at mean low-water. It was modified so as to increase the depth of channel in the lower part to 10 feet at mean low-water. It was completed in 1876. The amount expended prior to June 30, 1880, was $40,000.

This improvement allowed coasters of 13 feet draught to reach the wharfs at high-water without the aid of steam-tugs.

A plan with estimate of $44,050 for further improvement was transmitted to Congress at its last session, to comply with requirements of the river and harbor act of June 14, 1880 (see Appendix B 4), and the appropriation of $10,000 of March 3, 1881, will be expended during the fiscal year ending June 30, 1882, in accordance with that plan in protecting Long Beach and dredging near Wareham. It is expected with this to restore the depth at the shoal places and allow the 13-foot draught at high-water to be carried to Wareham, leaving the widening to the future.

The plan of improvement cannot be regarded as a permanent one, but will have occasionally to be repeated, as natural causes fill up the artificial channels.

Wareham is among the places earliest engaged in fabrication of iron, which still forms the principal business.

It is a port of delivery, is in the New Bedford collection district, and New Bedford is the nearest port of entry. The amount of revenue collected during the fiscal year ending June 30, 1881, was $23,806.42.

Amount appropriated by act approved March 3, 1881	$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	113 19
July 1, 1881, amount available	9,886 81
Amount (estimated) required for completion of existing project	34,050 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	20,000 00

(See Appendix B 4.)

5. *Taunton River, Massachusetts.*—This river rises in Norfolk County, Massachusetts, and empties into Mount Hope Bay, a name given to that part of Narragansett Bay lying mainly in Massachusetts. Taunton River is about 44 miles in length, measured along its course.

The condition of the river, before its improvement was commenced, was as follows: Beginning at the mouth near the city of Fall River for 6 miles to Somerset, it had sufficient width and depth for the largest coasting vessels. At Somerset it is crossed by a railroad bridge with two very narrow draw openings. Thence to Dighton, a distance of 2 miles, the ruling depth was about 11 feet at mean high-water. From Dighton to Berkeley Bridge, about 1 mile, the channel-way was narrow and obstructed by bowlders, with a depth of not more than 7½ or 8 feet at mean high-water. Berkeley Bridge has but one available draw-opening; this is 50 feet wide. From Berkely Bridge to Weir, a distance of 5 miles, the channel depth was not in places more than 5 feet at mean high-water. A vessel of 30 tons burthen was as large as could go up to Weir. Just above Weir a bridge, without a draw, crosses the river.

In 1870 an appropriation was made by Congress to increase the depth by dredging to 4½ feet at mean low-water, with the expectation that at high-water the depth would be 9 feet. This was based upon the rise of tide of 5¼ feet as determined at Dighton. In 1872 observations were made for rise of tide at various points on the river from Dighton to Weir. From these observations it was found that the rise of tide decreased from 5¼ feet at Dighton, to 3.4 feet at Weir. This difference in the rise of tide necessitated increased dredging in the upper part of the river to secure the desired navigable depth of 9 feet at mean high-water. The first project was completed in the fiscal year ending June 30, 1880. In 1880 Congress made an appropriation of $17,500 to increase the depth from 9 feet to 11 feet at mean high-water.

Amount expended to June 30, 1880, was $63,000. The river had at that time a navigable depth of 10 feet at mean high-water from Dighton to Berkeley Bridge, and thence to Weir 9 feet, with a channel width of 60 feet in its narrowest parts.

There was expended during the fiscal year ending June 30, 1881, $7,925.68 in dredging a channel 11 feet deep at mean high-water, from the bridge at Weir down river to "John R.'s" Shoal, a distance of about half a mile. This increased depth is not available in bringing in vessels of increased draught, but it gives loaded vessels a greater depth to lie in, so that they are less liable to injury from grounding while waiting to be unloaded.

The amount remaining on hand of the appropriation made by act of June 14, 1880, and the appropriation of $25,000 made by act of March 3, 1881, will probably be expended during the fiscal year ending June 30, 1882.

This will complete about one-half of the present adopted project, from the upper end down river. It will not be available for commerce until the channel is completed.

The estimated cost of completing the improvement in accordance with the approved project is $41,500. This amount could be profitably expended in the fiscal year ending June 30, 1883.

The city of Taunton, with 21,213 inhabitants, situated at the head of navigation on this river, is largely engaged in manufactures. The capital invested in manufactures is nearly $5,000,000. The amount paid out annually for labor in these factories is upwards of $2,500,000. The greater part of the raw material is brought in vessels. The amount of commerce on this river is upwards of 250,000 tons.

Taunton River is in the Fall River collection district. Fall River is the nearest port of entry. The amount of revenue collected in the fiscal year ending June 30, 1881, is not known at this office; in 1880 it was $12,699.28.

July 1, 1880, amount available	$17,500 00	
Amount appropriated by act approved March 3, 1881	25,000 00	
		$42,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	7,352 73	
July 1, 1881, outstanding liabilities	572 92	
		7,925 65
July 1, 1881, amount available		34,574 35
Amount (estimated) required for completion of existing project		41,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		41,500 00

(See Appendix B 5.)

6. *Pawtucket* (*Seekonk*) *River*, *Rhode Island*.—This is an estuary forming the continuation of Providence River from Providence to Pawtucket, a distance of 5 miles, and forms a shoal tidal basin of about 1½ square miles. The ruling low-water channel depth before it was improved was about 5 feet. The mean rise of the tide is 4.8 feet at Pawtucket.

The dredging was begun in 1867 to secure a ruling depth of 6 feet at mean low-water. It was found to silt up at places and the dredging was repeated. The project was modified to make a ruling mean low-water depth of 7 feet with a least channel width of 75 feet, and to include the clearing out of the east draw-span of the Red Bridge. This was practically completed in 1875, leaving at that time an unexpended balance of about $2,000.

In the season of 1879 observations for tides were repeated at several places and connected by lines of levels. (See annual report for 1880.)

The amount expended up to June 30, 1880, was $51,470.72. The dredged channel was at that time available (with some slight shoaling at places), but the navigation is seriously obstructed by a badly arranged draw-bridge near its lower end at East Providence, for the modification of which efforts are being made by local authorities.

No money was expended during the last fiscal year, and the condition of the navigation is substantially unchanged.

The increase in the size and draught of vessels of late years makes it desirable that the ruling mean low-water depth should be increased to 9 feet. This could probably be done for an additional appropriation of $33,000, which could be profitably expended in one year. This dredged material would have to be towed out of the river, which could not be done at the rate above estimated unless the Washington Bridge is rebuilt.

Pawtucket is a town of about 30,000 inhabitants, largely engaged in manufactures. In 1878 there were 350 schooners and 14 barges towed up the improved channel, having a freight of about 100,000 tons.

It is in the Providence collection district, that place being the nearest port of entry. The revenue collected there in the past fiscal year is $200,009.64.

The "project approved and adopted" is completed, and no further estimate is submitted,

There is available for contingencies $529.58 out of the sum of all the appropriations, which was $52,000.

July 1, 1880, amount available	529 58
July 1, 1881, amount available	529 58

(See Appendix B 6.)

7. *Providence River and Narragansett Bay, Rhode Island.*—Providence River is an estuary of Narragansett Bay, extending from Nayat Point to the city of Providence. Its length is about 7 miles, with a width varying from 1,000 feet to 2 miles, and a depth in the channel-way from 20 to 50 feet at mean low-water. Near its head this estuary is joined by another, called the Seekonk or Pawtucket River, extending 5 miles farther to the town of Pawtucket. The mean-rise of the tide is 4.7 feet.

Before any improvement was made, in 1853, the ruling low-water depths were as follows: By using the middle entrance to Narragansett Bay, the deepest draft vessels could ascend as far as Gaspee Point where the water shoals to a depth of 21 feet at mean low-water. This is about 5 miles from Providence. Between Gaspee Shoal and Pawtuxet Shoal at Sabin's Light, a distance of about half a mile, the channel is from 23 to 37 feet deep and about 500 feet wide. Pawtuxet Shoal had but about 18 feet depth at mean low-water. Between Pawtuxet Shoal and Field's Point, a distance of about 1½ miles, the depth varied from 23 to 45 feet at mean low-water, having a least width of 200 feet. This reach had in it Bulkhead Rock, with deep water around it but with only 7 to 8 feet at low-water upon it. Not far above Field's Point the channel depth shoaled to about 16 feet at mean low-water. Finally, on reaching the "Crook," at the junction of the Seekonk with the Providence River just below the city wharves, the available low-water depth was reduced to about 4½ feet.

The original project was to deepen the channel at the "Crook" to 9 feet at mean low-water. This was dredged in 1852–'53 under an appropriation of $5,000.

The next project was, in 1867, to increase the depth at the "Crook" to 12 feet at mean low-water; $23,000 was then expended at this place in dredging to a depth of 12 feet and width of 200 feet, and $2,000 in removing a wreck from Sabin's Point.

The next project was to increase the depth at the "Crook" to 14 feet at mean low-water. For this purpose an appropriation of $5,000 was used in 1870, making a channel having that depth for a least width of 130 feet.

In 1872 an appropriation of $10,000 was made, which was all expended in widening the channel-way of 12 feet depth at the "Crook."

In 1873 an appropriation of $10,000 was made to cut off the "Point of

Long Bed," which projected into the channel from the east side, just below "Sassafras Point Light." With this the worst of the point was removed.

The removal of Bulkhead Rock, in Providence River, was begun in 1870, and $2,500 was then expended in increasing the depth on it from about 8 feet to about 14 feet at mean low-water.

The foregoing expenditures amounted in the aggregate to $59,000, and had all been directed toward improving the navigation for coasting vessels.

The present project has in view the excavation of a capacious channel, suitable for large ocean steamers, and a much enlarged width for coasters. It is designed to secure a central depth of 23 feet at mean low-water for a width of 150 feet, a depth of 12 feet for a width of 940 feet, and a depth of 6 feet for a width of 1,060 feet. The depths are to increase gradually from the shoalest to the deepest water. The cost was estimated at $500,000.

The work was begun in 1878 under an appropriation of $50,000 for dredging and $5,000 for increasing the depth on Bulkhead Rock. The dredging was begun, under contract, that year and abandoned by the contractor. In 1879 an additional appropriation of $60,000 was made.

Up to June 30, 1880, there had been expended $61,757.79. By this expenditure the channel was made 23 feet deep for a width of 70 feet through the Pawtuxet Shoal—not wide enough to be of practical value. A channel 20 feet deep and 200 feet wide was made through the shoals above Field's Point, which was immediately available. It has been reserved till later to make the 23-foot channel depth above Field's Point.

The amount expended during the fiscal year ending June 30, 1881, including the removal of Bulkhead Rock so as to give a depth over it of 20 feet at mean low-water, is $79,072.69. In this time the 23-foot low-water channel through the Pawtuxet Shoal was increased to a width of 200 feet, and the 20-foot channel through the shoals above Field's Point to a width of about 450 feet. The city of Providence can now be reached at high-tides by vessels drawing about 25 feet.

An additional appropriation was made in 1881 of $60,000, so that the balance on hand June 30, 1881, was $85,412.58. This will be profitably expended during the fiscal year ending June 30, 1882, and will be applied in increasing the width of the channel at points of most immediate importance, according to the plan adopted and approved.

The estimated cost of the entire work was $500,000. Of this $230,000 have been appropriated, so that, according to the original estimate, $270,000 additional will be required. The impossibility of finding contiguous dumping-ground has increased the expense (for towage) about 10 per cent. over the original estimate. Further increased cost may be occasioned by the discovery of hard-pan or rock requiring removal.

This work is in the Providence collection district, and that place is a port of entry. The amount of revenue collected there during the fiscal year ending June 30, 1881, was $200,009.64.

July 1, 1880, amount available	$103,001 28	
Amount appropriated by act approved March 3, 1881	60,000 00	
		$163,001 28
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	74,330 56	
July 1, 1881, outstanding liabilities	3,258 14	
		77,588 70
July 1, 1881, amount available		85,412 58
Amount (estimated) required for completion of existing project		270,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		100,000 00

Removal of Bulkhead Rock.

July 1, 1880, amount available	$4,742 13
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,742 13

(See Appendix B 7.)

8. *Potowomut River, Rhode Island.*—This river is a small estuary of Narragansett Bay, situated about 13 miles from Newport. The channel of the river is obstructed by a bar at the mouth, on which the depth is 2.6 feet at mean low-water. This is an original project for improvement by dredging a channel 5 feet deep at mean low-water through the bar at the mouth.

A report of the survey and plan of improvement submitted is given in Appendix B 8.

The appropriation of $5,000, made at the last session of Congress, is deemed sufficient for the purpose, and will be expended in the fiscal year ending June 30, 1882.

No further appropriation is needed to complete the project.

This improvement is in the Providence collection district, and that place is the nearest port of entry. The amount of revenue collected there for the year ending June 30, 1881, is $200,009.64.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	48 99
July 1, 1881, amount available	4,951 01

(See Appendix B 8.)

9. *Newport Harbor, Rhode Island.*—This harbor is on the main entrance to Narragansett Bay, which is defended by Fort Adams. It is one of the most important harbors on the coast, furnishing a safe roadstead and anchorage for all classes of vessels. Newport itself is upon an inner harbor admitting the largest vessels, but its capacity is limited by shoals, so that it is no longer adequate for the convenience of the greatly increasing number of vessels seeking it.

Prior to 1872 the general business wharves of the city did not admit of the approach of vessels at low-tide of greater draft than 8 feet. The mean rise of the tide is about 3¾ feet.

The first projected improvement was to increase the depth of the approaches to the harbor-line for wharves to 12 feet at mean low-water, and to prevent the sand from being brought in around the south end of Goat Island. It was prepared to comply with requirements of the river and harbor act of June 10, 1872. The project, with some modifications, was completed in the fiscal year ending June 30, 1876. The amount appropriated and expended up to that time was $28,500. The results obtained were satisfactory, and the work remains in good condition.

In December, 1880, another project was estimated for, under resolution of the House of Representatives, to increase the anchorage depth in the inner harbor down to 13 feet at mean low-water where hard material did not exist, to the extent of 327,000 cubic yards, at a cost of $72,000. For this purpose an appropriation was made in March, 1881, of $25,000. No dredging was done during the fiscal year ending June 30, 1881. The last appropriation will all be expended during the fiscal year ending June 30, 1882, in carrying out the new project.

The additional amount required to complete the last project is $47,000, which can all be profitably expended in the fiscal year ending June 30, 1883.

The last project was made to meet an immediate necessity for more harbor capacity, and such occasion will recur when the addition now contemplated is found insufficient. What is being done is permanent, but the time and expense of the completion of the work cannot be determined.

Besides the city of Newport, Fort Adams, the torpedo station and training school of the Navy are located here, and vessels of all departments of our government and many ships of foreign powers make use of the harbor. It is one of the most important harbors of refuge for the coasting trade, and is a principal resort for the large fishing-fleets, both of sail and steam propulsion, and also of the yachting fleets. It is often crowded beyond its capacity, and danger of collision is imminent, because of the restricted anchorage ground.

Newport Harbor is in the Newport collection district. The amount of revenue collected there during the fiscal year ending June 30, 1881, was $2,036.37.

Amount appropriated by act approved March 3, 1881	$25,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	167 15
July 1, 1881, amount available	24,832 85
Amount (estimated) required for completion of existing project	47,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	47,000 00

(See Appendix B 9.)

10. *Block Island Harbor, Rhode Island.*—This island is a part of the State of Rhode Island, and its nearest point is about 10 miles south of the mainland. It is about 14 miles east of Montauk Point, on Long Island, and has deep water all around it.

The "harbor" is an artificial one, built for local purposes by the United States, in the years 1870 to 1879 inclusive, at a cost of $285,000. It is on the east side of the island, towards the southern part, and is formed by a riprap jetty or breakwater, to intercept the waves from the eastward, and has an "inner harbor" or wharf next the inside shore end of the breakwater, forming a basin about 250 feet by 300 feet, which was originally dredged to a depth of 7 feet at mean low-water. This latter in active seasons of the year is crowded to its full capacity. The mean rise of the tide is about 3 feet.

Before this work was built no decked vessels could find harbor on the island in a storm, and none were owned there. The local business so increased that in February, 1880, an estimate was called for to increase the entrance to and depth inside the inner harbor to 9 feet at mean low-water, to specially accommodate a small steamer belonging to the island. The act of June 14, 1880, appropriated $6,000 for this purpose and to remove a small wreck. The desired improvements were all completed during the fiscal year ending June 30, 1881, and included the removal of two large bowlders (then but recently discovered), within the sheltered area. The small balance on hand is reserved for contingencies.

This work may be considered as permanent (except that of the inner harbor, which is a timber crib-work), but it is probable that with the growth of commerce frequent extensions will be required. Its capacity is now hardly equal to the local wants. Besides the wants of the mackerel-fishing fleet and the general coast navigation, the island is an important point on our shores for ocean navigation. It has a signal station connected by submarine telegraph with the mainland. Vessels are passing the island at all times and on all sides of it, and its position renders it of national importance.

No appropriation is asked for the fiscal year ending June 30, 1883.

Block Island is in the Newport collection district. The amount of revenue collected there in the year ending June 30, 1881, was $2,036.37.

July 1, 1880, amount available	$6,000 00
July 1, 1881. amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	5,873 74
July 1, 1881, amount available	126 26

(See Appendix B 10.)

11. *Little Narragansett Bay, Rhode Island and Connecticut.*—This bay is at the mouth of Pawcatuck River, and is between Stonington and Watch Hill. The water in the bay was so shoal that 4½ feet was but the greatest depth that could be carried across it at low-water. The Pawcatuck River, navigable to Westerly, can only be approached through this bay. This river has been improved by the United States, and has now a channel 75 feet wide and 5½ feet deep at mean low-water.

The original project adopted in 1878 provides for a channel across the bay 200 feet wide and 7½ feet deep at mean low-water, and also the removal of a few rocks.

The amount expended up to June 30, 1880, was $19,798.58. The work accomplished had made a channel through the hard material at the east end of the channel, 185 feet wide, and the rest of the proposed channel 40 feet wide. The most dangerous rocks had been removed. The channel was in part too narrow to be of much use to navigation.

The amount of money expended during the fiscal year ending June 30, 1881, increased the width of the narrow part of the new channel from 40 to 60 feet. The work is still in progress, and with the sum available at the beginning of the new fiscal year it is expected will make the least width of the channel 140 feet. It will be of use to the navigation this autumn.

The amount of the estimate required to complete the original project is $21,000. This could be profitably expended during the fiscal year ending June 30, 1883.

The number of vessels taken through Little Narragansett Bay during the year 1878 was 205. There were 31 vessels drawing too much water to cross the bay that were lightered at Stonington and their cargoes taken to Westerly.

Little Narragansett Bay is in the collection districts of Providence and Stonington; the latter is the nearest port of entry. The revenue collected during the fiscal year ending June 30, 1880, was: Providence, $200,009.64; Stonington, $2,511.69.

July 1, 1880, amount available	$5,201 42	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$10,201 42
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		490 13
July 1, 1881, amount available		9,711 29
Amount (estimated) required for completion of existing project		21,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		21,000 00

(See Appendix B 11.)

12. *Connecticut River above Hartford, Connecticut, and below Holyoke, Massachusetts.*—From Hartford to Windsor Locks at the foot of Enfield Falls, a distance of 10¾ miles, the river has a sedimentary bed and banks, and is naturally shoal at low-water, giving sometimes, where not improved, a depth of only 18 inches. Then Enfield Falls—a rock rapid—extending 5¼ miles, prevents all navigation at the present time; but vessels drawing 3 feet can pass around them by means of the canal,

having locks 80 feet by 18 feet. This canal is owned by a corporation charging toll, and is mainly used to furnish water-power. From the head of the "Falls" to Holyoke the navigation is good, having a low-water depth of not less than 5 feet. There is seldom any useful tide from the ocean above Hartford.

A history of the improvement is given in full, in the Annual Report for 1878, Part I, pp. 247–393, up to that date. (Surveys and estimates were begun in 1870.) The final object to be reached has been a permanent improvement that would insure a low-water navigation throughout of at least 8 feet. In the mean time local wing-dams and dredging have been resorted to, to relieve the part between Hartford and Enfield Falls, to secure 3 feet.

The part of the river above Hartford and below Holyoke is fully reported upon in Appendix B, Annual Report for 1878. Revised estimates were submitted January 3, 1881, which are appended to the report of the engineer in charge for the present year. This provides for a canal $17\frac{3}{10}$ miles long from below Hartford to the head of the Enfield Falls, with locks 200 feet × 50 feet × 8 feet, at an estimated cost of $1,322,805. Something in addition will have to be added to make a low-water navigation of 8 feet up to Holyoke. No work has yet been done upon this main project.

Prior to June, 1880, the amount expended between Hartford and Holyoke for surveys and reports was about $32,000, and for works of improvement about $25,087.14. At points where local work for temporary relief had been done the results were satisfactory, but changes that have taken place left the river, at extreme low-water, in about the original unnavigable condition, and further temporary works have been planned at the Farmington River Shoals.

During the fiscal year ending June 30, the work at the Farmington River Shoals was completed at an expenditure of $4,919.70. It is too soon to say what the result will be.

The means available are ample to continue the works of temporary alleviation, but not enough to even begin the permanent plan of improvement. This latter will require at least three years, and should not be begun with less than one-third of the estimate—about $450,000.

The benefit to be secured by the permanent work is to cheapen the transportation of bulky articles, such as coal, iron, and provisions, into a large manufacturing region now only reached by railroads. It includes the city of Springfield (at which is a United States Armory) and Holyoke, on the Connecticut, and other smaller places, and will be beneficial to the works at Miller's Falls, and may eventually be extended further.

This part of the river is in the Middletown collection district, which is a port of entry. The revenue collected there in the fiscal year ending June 30, 1881, is $66,196.73.

Above Hartford and below Enfield Falls.

July 1, 1880, amount available		$7,120 04
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$3,000 79	
July 1, 1881, outstanding liabilities	219 78	
		3,220 57
July 1, 1881, amount available		3,899 47

On or above Enfield Falls, Connecticut, and below Holyoke, Massachusetts.

July 1, 1880, amount available	10,702 92
July 1, 1881, amount available	10,702 92

Between Hartford, Connecticut, and Holyoke, Massachusetts.

July 1, 1880, amount available	$15,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,330 20
July 1, 1881, amount available	13,669 80

(See Appendix B 12.)

13. *Connecticut River below Hartford, Connecticut.*—The Connecticut River from Hartford to its mouth at Saybrook is about 50 miles in length. The tide, which at the mouth of the river rises about 3½ feet, rises but about 1 foot at Hartford when the river is at its lowest stage; when the river is 5 feet above its lowest stage the rise of tide is not appreciable at Hartford.

The chief obstacles to the free navigation of this river are, the bar at the mouth and the shoals between Middletown and Hartford, a distance of 16 miles. The most troublesome shoals are between Rocky Hill and Hartford, a distance of 9 miles, where the river banks are alluvial.

The depth on the bar at Saybrook was, before commencing jetties, about 6 feet at mean low-water.

The shoals between Hartford and Rocky Hill form at every flood stage of the river, and require dredging to give the requisite 9 feet depth at low-water for the boats running between New York and Hartford.

The subject of improving this part of the river proper has received attention from a very early period, and work has been done upon it of a temporary character by the United States since 1870. In 1872 a thorough survey was made at Saybrook Bar and jetties designed for its permanent improvement. (See Appendix W 16, Annual Report 1873, for a full account of this bar.) In 1879 an accurate survey was made for the first time between Hartford and Rocky Hill, and a plan was proposed for the permanent improvement of this portion. (See Annual Report 1880, Appendix B 12).

The amounts expended since 1870 and prior to June 30, 1880, on surveys and improvements are about as follows: At Saybrook Bar, $115,000; between Middletown and Hartford, about $114,203.

The results have been a steady improvement of the navigation at Saybrook Bar, where the jetties are so nearly complete as to produce beneficial effect, and the ruling low-water depth has been increased from 6 feet to 8 feet.

Between Middletown and Saybrook the dredging of certain shoals has had to be annually repeated at low-water, and although this has afforded temporary relief, it was not possible often for it to be timely. Its unsatisfactory character has led to the adoption of a permanent plan of improvement, but the temporary dredging will have to be continued till the other is completed.

Of the amount expended during the fiscal year ending June 30, 1881, about $7,493.58 was upon jetties at Saybrook, and about $5,129.04 in temporary dredging between Rocky Hill and Hartford. The result was similar to previous year's work—an increase of depth at Saybrook Bar and temporary channel through shoals above Rocky Hill.

The money available July 1, 1881, will be expended partly upon Saybrook Bar, partly in dredging temporary channel at low-water, and partly on the wing-dam at Glastonbury Bar, which forms part of the permanent river improvement. The permanent river improvement will require an additional $318,000. The improvement at Saybrook is progressive in its character, and its ultimate cost will depend upon the depth the future may demand, and may require a part of each appropriation. The temporary work will require about $5,000 annually.

The amount that can be profitably expended in the fiscal year ending June 30, 1883, is $109,000.

The business transportation that is now carried on is shown on page 399, Annual Report 1880, Appendix B 12.

This part of the Connecticut River is in the Middletown collection district, and that place is the nearest custom-house. The amount of revenue collected there during the year ending June 30, 1881, was $66,193.73.

July 1, 1880, amount available	$18,318 66	
Amount appropriated by act approved March 3, 1881	30,000 00	
		$48,318 66
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		12,622 62
July 1, 1881, amount available		35,696 04
Amount (estimated) required for completion of existing project		318,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		109,000 00

(See Appendix B 13.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with provisions of the river and harbor act of June 14, 1880, Lieutenant-Colonel Warren was charged with the survey and examination of—

1. *Wareham Harbor, Massachusetts.* (See Appendix B 4.)
2. *Potowomut River, Rhode Island.* (See Appendix B 8.)

The reports of the results have been transmitted to Congress and printed in House Ex. Doc. No. 18, Forty-sixth Congress, third session.

To comply with provisions of the river and harbor act of March 3, 1881, he has been charged with the examinations or surveys of—

1. *Edgartown Harbor and South Beach, Massachusetts.*
2. *Buzzard's and Barnstable bays, Massachusetts, at the entrance of the proposed Cape Cod Canal.*

This will be done during the present season, and the results duly submitted.

IMPROVEMENT OF HARBORS AND RIVERS ON LONG ISLAND SOUND.

Officer in charge, Maj. J. W. Barlow, Corps of Engineers.

1. *Stonington Harbor, Connecticut.*—The harbor of Stonington was originally an open bay, unprotected from southerly storms, and containing a middle ground with but 6 feet depth of water at the shoalest part.

This obstruction covered the greater portion of the harbor, and left but a narrow channel on either side, with insufficient space for vessels of 12 feet draught to reach the upper wharves at low-water.

A small breakwater or pier, costing $36,753, was built in 1828–'30 from the east shore to protect the commerce of the village.

Plans for more extensive improvements were considered in 1872, the object being to afford, by means of additional breakwaters a considerable anchorage to serve as a harbor of refuge for general commerce, and also to increase the depth of the harbor by dredging to 12 feet at mean low-water.

During the seasons of 1873–'74, $45,000 was expended in dredging, which resulted in enlarging the channel to the steamboat wharf by removing the northern portion of the middle ground to a depth of 12 feet. Subsequently a breakwater off Wamphassuck Point, 2,000 feet in length, was built; and another in the vicinity of Bartlett's Reef, southeast of the harbor, was commenced. The completion of the latter will afford a harbor of large dimensions, thoroughly sheltered and available as anchorage for vessels drawing 18 feet of water.

The total amount expended to June 30, 1880, is $177,067.65.

Operations during the year ending June 30, 1881, have resulted in finishing the Wamphassuck Point breakwater, and constructing 500 feet of the one near Bartlett's Reef. The latter structure is designed to be about 2,000 feet long, and is estimated to cost $100,000.

July 1, 1880, amount available	$33,552 18	
Amount appropriated by act approved March 3, 1881	30,000 00	
		$63,552 18
July 1, 1881, amount expended during the fiscal year, exclusive of outstanding liabilities July 1, 1880		33,525 86
July 1, 1881, amount available		30,026 32
Amount (estimated) required for completion of existing project		45,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		45,000 00

(See Appendix C 1.)

2. *New London Harbor*, *Connecticut.*—This harbor is naturally the finest on Long Island Sound, and one of the best in the United States. It is accessible for all classes of vessels at all seasons of the year, and is extensively used as a harbor of refuge.

The improvement now in progress consists in removing a shoal in the upper part of the harbor above the city of New London, which obstructs the approach to the large receiving and shipping wharf of the New London & Northern Railroad Company. The project for the removal of this shoal was adopted to comply with the terms of the river and harbor act of June 14, 1880, which directed that the sum of $2,500 should be applied to that object. This sum was expended in dredging during the past season, resulting in the removal of 1,222 cubic yards of material.

The original estimate ($6,800) for the entire removal of the shoal was based upon a probable price for dredging, which was greatly exceeded in the contract for the work. It is therefore probable that the balance of the original estimate, $4,300, which is now available for expenditure, will be inadequate for completing the work, and a further sum of $17,200 is recommended by the officer in charge, which could be profitably expended during the year ending June 30, 1883.

July 1, 1880, amount available	$2,500 00	
Amount appropriated by act approved March 3, 1881	4,300 00	
		$6,800 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,500 00
July 1, 1881, amount available		4,300 00
Amount (estimated) required for completion of existing project		$17,200 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		17,200 00

(See Appendix C 2.)

3. *Thames River*, *Connecticut.*—The navigation of this river was originally obstructed by shoals for a distance of about 3 miles below the city of Norwich, the depth in some places being but 7 feet at low-water, and the channel narrow and tortuous.

In 1830 plans were adopted for improving navigation, with a view to affording a channel 100 feet wide and 14 feet deep at mean high-water.

These plans included, besides a large amount of dredging, the construction of several wing-dams on each side of the channel to straighten and confine the currents. To secure and maintain this channel an aggregate of $169,000 was expended from 1830 to June 30, 1880.

The present project contemplates increasing the depth through the shoals to 14 feet at mean low-water, or 3 feet more than was at first attempted. To accomplish this, it will be necessary to repair and lengthen several of the old wing-dams, build two or more new ones, and dredge a channel to the depth and width sought throughout a distance of about 3 miles.

Operations during the year ending June 30, 1881, have been confined to dredging, and resulted in removing 9,387 cubic yards of material from the channel below Norwich and increased the depth at the most troublesome shoal from 2 to 3 feet.

The unexpended balance of last year's appropriation will be applied to dredging under existing contract.

With the sum of $30,000, appropriated at the last sessssion of Congress, a dike about 1,600 feet in length will be constructed at Trading Cove Flats, and dredging to afford a depth of 14 feet at mean low-water will be continued.

July 1, 1880, amount available	$25,404 13	
Amount appropriated by act approved March 3, 1881	30,000 00	
		$55,404 13
July 1, 1881, amount expended during the fiscal year, exclusive of outstanding liabilities July 1, 1880	3,849 21	
July 1, 1881, outstanding liabilities	2,159 01	
		6,008 22
July 1, 1881, amount available		49,395 91
Amount (estimated) required for completion of existing project		64,200 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		64,000 00

(See Appendix C 3.)

4. *New Haven Harbor, Connecticut.*—This harbor was originally a broad open bay, exposed to southerly storms, and dangerously obstructed at the entrance by several sunken rocks.

To the removal of these rocks the first efforts for improvement were directed in 1852.

The upper part of the harbor was so shallow that vessels exceeding 9 feet draught were unable to reach the city wharves at low-water.

Plans for dredging a channel of navigable width and 13 feet depth at mean low-water were adopted in 1871, and modified in 1878, to make the depth 16 feet at mean low-water throughout the entire channel.

The amount expended in improving this harbor from 1852 to 1880 is $151,200, and had resulted in obtaining a channel 16 feet deep and nearly 400 feet wide from Fort Hale to Tomlinson's Bridge.

Operations during the year ending June 30, 1881, have resulted in the removal of 110,000 cubic yards of material from the channel between Long Wharf and Tomlinson's Bridge, increasing the width to 400 feet and making the depth 16 feet at mean low-water.

The sum of $15,000 appropriated at the last session of Congress will be devoted to dredging, with a view to increasing the width of the 16-foot channel between Fort Hale and Long Wharf. To secure a like depth on the bar just below Fort Hale, the construction of a dike on the west side, running south from Sandy Point, is recommended by the officer in charge. The length of the dike would be 4,400 feet, and its cost $60,000.

July 1, 1880, amount available	$19,790 55	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$34,790 55
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		16,665 82
July 1, 1881, amount available		18,124 73
Amount (estimated) required for completion of existing project		60,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		60,000 00

(See Appendix C 4.)

5. *Breakwater at New Haven, Connecticut.*—This harbor was originally exposed to the severity of all southerly storms, so that vessels seeking its protection were compelled to anchor in the upper harbor, where the channel was narrow and shoal, affording insufficient room for the ordinary commerce of the city. Under such circumstances the harbor was of little value as a harbor of refuge.

A project for the construction of two breakwaters at the entrance was adopted in 1879, the object being to afford a safe refuge for the general commerce of Long Island Sound, and to secure at the same time a convenient anchorage for the shipping of the harbor.

The line adopted for the east breakwater extends from Southwest Ledge, the location of the new light-house, to Quixe's Ledge, in a northeast direction, a distance of 3,300 feet.

The amount expended to June 30, 1881, is $59,706.15, and has resulted in the delivery of 64,392 tons of riprap and the building of 690 linear feet of completed work.

With the sum of $60,000 appropriated at the last session of Congress it is proposed to continue the construction of the breakwater on the present line, extending it towards Quixe's Ledge as far as the funds will allow.

It is of great importance to the interests involved that this improvement be pushed forward rapidly, as little benefit will be derived from the money expended until the greater part of the work shall have been accomplished.

The sum of $200,000 can be profitably applied during the fiscal year ending June 30, 1883.

The estimated amount required for the entire and permanent completion of the two breakwaters is—

East breakwater	$537,800 00
West breakwater	653,334 00

July 1, 1880, amount available	$52,877 22	
Amount appropriated by act approved March 3, 1881	60,000 00	
		112,877 22
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		52,583 37
July 1, 1881, amount available		60,293 85
Amount (estimated) required for completion of existing project		1,191,134 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		200,000 00

(See Appendix C 5.)

6. *Milford Harbor, Connecticut.*—The outer harbor or bay is an indentation of the north shore of Long Island Sound, about 9 miles west of New Haven, and is formed by the projecting headlands of Welch's Point and Charles Island. It has good holding ground, and is sheltered from

northerly winds, but exposed to those from the south. A small stream, the Wepawang, joined by the Indian River near its mouth, enters this bay at its head. The tide in the Wepawang extends as far up as the village of Milford, which is situated about one-half a mile above the head of the bay.

The channel of this stream was originally bare at low-water throughout the greater part of its length, and a sand-bar obstructed the entrance below its mouth.

The plans for improvement adopted in 1872 contemplated the construction of jetties along Welch's Bluff to prevent erosion and the washing of material into the harbor, a long jetty at the mouth of the river, and dredging through the bar below and in the river above.

A breakwater off Welch's Point was also recommended to form an outer harbor of refuge and more perfectly protect the bluff from the action of the sea.

With the exception of the breakwater, the improvements have been executed, and the upper channel extended as far as the village of Milford.

The amount expended to June 30, 1880, is $34,500, and had resulted in securing a channel of entrance 100 feet wide and 4 feet deep at mean low-water, with an extension of like depth 60 feet wide and about 4,000 feet in length to the village wharves.

The appropriation of June 14, 1880, has been applied in extending the dredged channel to the upper wharves of the village, a distance of 1,100 feet, and in making one cut at the entrance to the harbor 8 feet deep at mean low-water.

An entrance channel of this depth and 100 feet wide, as desired by those interested in this harbor, would require the removal of 45,000 cubic yards, costing about $11,000. Should this project meet with approval, the whole amount could be most profitably applied during the next fiscal year.

July 1, 1880, amount available	$5,177 33
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	5,101 14
July 1, 1881, amount available	76 19
Amount that can be profitably expended in fiscal year ending June 30, 1883.	11,000 00

(See Appendix C 6.)

7. *Housatonic River, Connecticut.*—The entrance to this river was originally obstructed by a sand bar caused by the action of storms upon the adjacent shore; the channel depth over this bar at mean low-water being from 3 to 4 feet.

In the river above, navigation was impeded by several shoals, having a depth upon them of but 4 feet at mean low-water.

The Housatonic is a tidal stream to the dam of the Ousatonic Water Company, 16 miles above its mouth. At this point are situated the manufacturing towns of Derby, Shelton, and Birmingham, the river furnishing water-power for their numerous mills.

The improvement of this river was begun in 1871, the object being to afford a navigable channel of not less than 7 feet depth from its mouth to the head of tide-water.

The sum of $60,000 had been appropriated in small amounts from 1870 to 1880, and devoted mainly to the removal of shoals above the mouth of the river, nothing beyond a survey having been attempted at the entrance.

A channel through the several bars with a width of 60 feet and a depth of 7 feet at mean low-water has been generally maintained by dredging. The bars being due to the movement of sand in time of freshets will frequently recur, and will require periodical appropriations for their removal. During the past year a 7-foot channel 60 feet wide has been dredged through the bar just below Stratford, and with the appropriation made at the last session of Congress, the channel through Drew's Bar and near the camp-meeting ground will be restored.

July 1, 1880, amount available	$2,122 68	
Amount appropriated by act approved March 3, 1881	2,000 00	
		$4,122 68
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,070 08
July 1, 1881, amount available		2,052 60
Amount that can be profitably expended in fiscal year ending June 30, 1883.		5,000 00

(See Appendix C 7.)

8. *Bridgeport Harbor, Connecticut.*—The entrance to this harbor was originally obstructed by two shoals known as the outer and inner bars. The channel was narrow with a depth of but 5 feet on the outer bar and from 4 to 6 feet on the inner bar at mean low-water.

Improvements were begun in 1836, and consisted in dredging a channel through the bars to secure a depth of 8 feet at mean low-water. With this end in view several appropriations had been applied to the work, when in 1871 the construction of a riprap jetty from the east shore was undertaken for the double purpose of arresting the movement of sand from the beach into the harbor, and strengthening the tidal currents over the bars. The effect of this jetty has been most favorable.

The amount expended from 1836 to June 30, 1880, chiefly in dredging, is $175,000, affording a channel 300 feet wide from Long Island Sound to the city wharves, and at least 9 feet deep at mean low-water, with a mid-channel depth of 12 feet. The channel was also extended with a width of 100 feet and depth of 9 feet from the lower bridge to the Horse Railroad Bridge, a distance of about 3,000 feet.

With the sum of $10,000 appropriated by act of Congress approved March 3, 1881, the improvement of the harbor under existing plans will be completed.

There is a rapidly increasing demand for more anchorage area above the inner beacon, caused by the extensive use of the harbor for refuge. To meet the views of those interested in this subject the removal of 498,000 cubic yards of material will be required, at a cost of $60,000. Should this project be approved the sum of $10,000 could be profitably expended during the next fiscal year.

July 1, 1880, amount available	$10,031 30	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$20,031 30
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		9,947 19
July 1, 1881, amount available		10,084 11
Amount that can be profitably expended in fiscal year ending June 30, 1883.		10,000 00

(See Appendix C 8.)

9. *Southport Harbor, Connecticut.*—The navigation of Mill River, now known as Southport Harbor, was originally almost impracticable, the

natural channel being shallow and obstructed by bars formed from deposits of sand in easterly storms.

The plan for improvement adopted in 1827 embraced the construction of a breakwater running south from the sand spit opposite Southport; a dike extending northward in prolongation of the line of the breakwater, and deepening the channel through the bars by dredging.

An aggregate of $13,087.43 was expended under this plan which resulted in diminishing the formation of bars and securing a navigable channel of sufficient dimensions to meet the commercial wants of the village.

Since 1875, $12,500 has been appropriated for the purpose of repairing the breakwater and dike, and dredging to secure a channel depth of 4 feet at mean low-water.

During the fiscal year ending June 30, 1881, the sum of $2,500 was expended in increasing the width and depth of the channel from the breakwater to the town wharves.

The sum of $2,500, appropriated by act of March 3, 1881, will be applied to completing the upper channel and increasing the width below the breakwater.

July 1, 1880, amount available	$2,521 60	
Amount appropriated by act approved March 3, 1881	2,500 00	
		$5,021 60
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,510 18
July 1, 1881, amount available		2,511 42
Amount (estimated) required for completion of existing project		3,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		3,000 00

(See Appendix C 9.)

10. *Norwalk Harbor, Connecticut.*—With the exception of a survey in 1829, the government had made no expenditure in improving this harbor previous to 1871. The channel was then obstructed at several places by deposits of mud leaving a depth of from 1 to 2 feet at mean low-water, and immediately below the stone bridge at Norwalk, a large middle ground of gravel and bowlders had formed, bare at low-water and nearly covering the entire basin.

The improvement of the channel adopted in 1871, purposed increasing the depth through the several shoals to 6 feet at mean low-water and making the width 100 feet from Long Island Sound to the village of Norwalk.

An aggregate of $53,000 had been expended under this project to June 30, 1880, which resulted in furnishing a depth of not less than 6 feet at mean low-water, throughout the entire channel for a width of 60 to 100 feet, and the complete removal of the deposit of gravel and bowlders which formed the middle ground at Norwalk.

During the fiscal year ending June 30, 1881, the sum of $5,000 has been expended in improving the channel below the New York and New Haven Railroad bridge, making the depth 8 and the width 100 feet, for a length of 2,200 feet.

The sum of $5,000, appropriated by act of Congress of March 3, 1881, will be applied to the further improvement of the channel below the railroad bridge, and to the removal of shoals near Ferry's Point, and Squirrel Flats, formed by the ice during the past winter.

After the completion of the project, small sums will probably be required periodically to repair injuries arising from freshets.

July 1, 1880, amount available	$5,043 62	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$10,043 62
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		5,019 09
July 1, 1881, amount available		5,024 53
Amount (estimated) required for completion of existing project		$15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		10,000 00

(See Appendix C 10.)

11. *Port Jefferson Harbor, New York.*—Port Jefferson Harbor has an available anchorage of 1½ square miles, with a depth of from 15 to 30 feet at mean low-water. It is completely land-locked and admirably situated for a harbor of refuge. A gravel bar originally obstructed the mouth of the harbor, leaving but a narrow entrance, which had not more than 4 feet depth at mean low-water.

A survey was made in 1853, but no appropriation for improvement was granted until 1871, when plans were recommended for the construction of a breakwater at the east side of the entrance to stop the movement of material towards the channel, and for dredging through the bar to a depth of 7 feet.

In 1875 the plan was modified by the addition of a second jetty from the west beach, and in 1877 by increasing the proposed depth to 8 feet at mean low-water.

The sum of $64,000 has been expended under the above plans, and has resulted in obtaining a channel of entrance 100 feet wide and 8 feet deep at mean low-water. The sum of $3,000, appropriated by act of Congress of June 14, 1880, has been applied to repairing and lengthening the jetties with a view to more thoroughly preventing the deposit of sand and gravel upon the bar and maintaining the depth already gained.

With the appropriation of $4,000, made by act of March 3, 1881, the work of lengthening the jetties will be continued. The amount required for the completion of the work in accordance with approved plans is $8,000, which sum could be profitably expended during the fiscal year ending June 30, 1883.

July 1, 1880, amount available	$4,605 67	
Amount appropriated by act approved March 3, 1881	4,000 00	
		$8,605 67
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,780 93	
July 1, 1881, outstanding liabilities	2,535 00	
		4,315 93
July 1, 1881, amount available		4,289 74
Amount (estimated) required for completion of existing project		8,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		8,000 00

(See Appendix C 11.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with provisions of the river and harbor act of June 14, 1880, Major Barlow was charged with a survey with the view of *opening a channel between Lloyd's Harbor and Cold Spring Bay, New York.* The report of the result was transmitted to Congress and printed in H. Ex. Doc. 31, Forty-sixth Congress, third session. (See also Appendix C 12.)

And to comply with provisions of the river and harbor act of March 3, 1881, he has been charged with the following:

1. *Harbors of Madison and Clinton, Connecticut.*
2. *Greenport Harbor, New York.*
3. *Harbor of Mamaroneck, New York.*
4. *Survey for breakwater and harbor of refuge at Milford, Connecticut.*

The results of which will be duly submitted when received.

IMPROVEMENT OF HUDSON RIVER—REMOVAL OF OBSTRUCTIONS IN EAST RIVER AND HELL GATE—IMPROVEMENT OF BUTTERMILK CHANNEL, NEW YORK HARBOR; OF FLUSHING, CANARSIE, SHEEPSHEAD, AND GOWANUS BAYS AND SUMPAWAUMUS INLET; OF HARLEM RIVER, NEWTOWN AND EAST CHESTER CREEKS; THE HARBORS OF RONDOUT, ECHO, PORT CHESTER, AND NEW ROCHELLE, NEW RORK, AND OF RARITAN AND SOUTH RIVERS AND CHEESEQUAKES CREEK, NEW JERSEY.

Officer in charge, Col. John Newton, Corps of Engineers, with Lieut. G. McC. Derby, Corps of Engineers, under his immediate orders.

1. *Hudson River, New York.*—The original condition of the navigable channel was between New Baltimore and Barren Island a depth at mean low-water of 7½ feet; at Coeyman's, 8½ feet; at Mull's, 9 feet; at Castleton, 8 feet; at Cedar Hill, 7½ feet; at Winnie's, 9.4 feet; on the Overslaugh, 7.7 feet; at Cuyler's Bar, 9 feet; at Round Shoal, 7.2 feet. That is, at low-water, 7½ feet could be carried from New Baltimore to Albany; to Troy, 7.2 feet. The channels, however, were very crooked, in places very narrow, and of such difficult navigation that the grounding of boats was, it might almost be said, the rule and not the exception.

The originally adopted project for the improvement was the construction of longitudinal dikes generally of the height of mean high-water, to direct the currents and allow the flow over their top of freshets and of ice.

The amount expended therein to the close of the fiscal year ending June 30, 1880, was $881,441.14.

The condition of the improvement at that period was a navigable depth from New Baltimore to Albany at mean low-water of 9½ feet, and from Albany to Troy of 8 feet, as reported by Lieut. J. H. Willard, Corps of Engineers.

During the year ending June 30, 1881, there has been expended $18,718.02; the results in the way of increased depth and facilities for navigation are not known for want of a recent survey.

The amount available on June 30, 1881, will be devoted to the removal of Austin's Rock, and the restoration and repair of lines of piles and of dikes.

The benefits to be expected will be a greater width and depth of navigable channel and a relief from being wrecked and sunk upon rocky reefs.

The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is $30,000.

July 1, 1880, amount available	$57,935 89	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$72,935 89
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		18,718 02
July 1, 1881, amount available		54,217 87
Amount (estimated) required for completion of existing project		30,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		30,000 00

(See Appendix D 1.)

2. *Rondout Harbor, New York.*—The original condition of the navigable channel gave a depth of about 7 feet at mean low-water. The originally adopted project was the prolongation of the channel of Rondout Creek into the Hudson River by the construction of two parallel dikes and of a branch dike to direct the current of the river and to protect the north dike from the floating ice, and there has been no modification of the original project.

The amount expended to June 30, 1880, was $88,294.65, and at that time the depth in the channel was 13½ feet at mean low-water.

There has been expended during the year ending June 30, 1881, for incidental purposes only, the sum of $344.16, without effect upon navigation.

The sum that can be profitably expended during the fiscal year ending June 30, 1882, is the available balance of $2,361.19 for repairs to dikes arising from collisions of vessels, &c., and upon the removal of a portion of the south dike at its extremity.

The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project would be at most $1,000 or $2,000, to be used in removing any portion deemed necessary of the extremity of the south dike.

July 1, 1880, amount available	$2,705 35
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	344 16
July 1, 1881, amount available	2,361 19
Amount (estimated) required for completion of existing project	2,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	2,000 00

(See Appendix D 2.)

3. *Obstructions in East River and Hell Gate, New York.*—The original condition of the channel of East River and Hell Gate was the existence of many large and dangerous rocky obstructions to navigation. The depth over Diamond Reef was at mean low-water 17½ feet; over Coenties Reef, 14.3 feet; over Frying Pan, 11 feet; over Pot Rock, 20 feet; over Heel Tap 12.1 feet; over reef at North Brother, 16 feet. Hallet's Point from the shore of Astoria projected under water 325 feet to the contour line of 26 feet at mean low-water, and embraced an area of about 3 acres. The Middle Reef, with an area of about 9 acres, lay in the middle of the channels at Hell Gate, having a small backbone projecting above high-water, caught vessels swept upon it by the ebb currents which passed directly over the rock. Hallet's Point and the Middle Reef may be said to have been alternate in mischievous functions; vessels which escaped one ran a great risk of falling upon the other. What added considerably to the danger from these reefs was the bend at right angles of the river at the spot.

The originally adopted project for the improvement was the least extensive of three projects discussed by the engineer in charge; that one now being carried out was judged by the authorities in 1867 to be too extensive and costly. The project first adopted was the removal of Pot Rock, Frying Pan, Way's Reef, Shelldrake, the rock off Negro Point, the rocks near Woolsey's bath-house, Blackwell's Rock, portions of Hallet's Point, and of Scaly Rock. Sea-walls were designed for the Middle Reef, Hogsback, the Bread and Cheese, and a beacon for Rylander's Reef.

The project most favored by the engineer in charge, which included likewise the total removal of Hallet's Point and of the Middle Reef, has, as time passed, received the approval of the authorities. The project first intended solely for Hell Gate has also been modified by incorporating with it rocky obstructions in the East River, Diamond Reef, Coenties Reef, and a reef near the North Brother.

The amount expended thereon to the close of the fiscal year ending June 30, 1880, was $2,359,280.57.

The condition of the improvement was the removal of Diamond, Coenties, Way's Reef, and Shelldrake to the depth of 26 feet at mean low-water, the tunneling and explosion of Hallet's Point and the removal of a large portion of the débris with a least depth over any portion of 17 feet at mean low-water, the tunneling of the Middle Reef (Flood Rock) to the extent of 6,211.08 linear feet and the removal therefrom of 21,529.38 cubic yards of stone measured in place. The "Bread and Cheese," a dangerous reef, has been inclosed and embanked by the commissioners of charities and correction of New York City.

The amount expended during the year ending June 30, 1881, was $256,981.47. The area off Hallet's Point which has been brought to the depth of 26 feet at mean low-water is about two-thirds of the whole area and double of what it was on June 30, 1880. The least depth on the remaining portion not removed to full depth is 19 feet at mean low-water. Heel Tap Rocks have been broken up; the tunnels at the Middle Reef (Flood Rock) during the year were driven an additional length of 7,312 linear feet, with the removal of 18,080 cubic yards of stone measured in place.

The amount available on June 30, 1881, will be expended in completing the removal of the débris at Hallet's Point to the depth of 26 feet at mean low-water, removing Heel Tap and the reef at the North Brother, with some work on Frying Pan and Pot Rock, and in extending the tunnels and excavations in the Middle Reef (Flood Rock).

The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is $2,215,078.55.

July 1, 1880, amount available	$296,638 81	
Amount received from sale of coal to Capt. James Mercur	123 75	
Amount appropriated by act approved March 3, 1881	200,000 00	
		$496,762 56
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	188,859 40	
July 1, 1881, outstanding liabilities	57,385 13	
		246,244 53
July 1, 1881, amount available		250,518 03
Amount (estimated) required for completion of existing project		2,215,078 55
Amount that can be profitably expended in fiscal year ending June 30, 1883		300,000 00

(See Appendix D 3.)

4. *Buttermilk Channel, New York.*—The channel in its original condition was obstructed by a large shoal with a minimum depth of 9½ feet at mean low-water, which lay in the direct track of navigation, too near the wharves of Brooklyn for the safe passage or maneuver of large vessels.

The originally adopted project for the improvement was the removal of a sufficient portion of this shoal to the depth of 26 feet at mean low-water, and thereby to increase the depth and width of the channel.

Nothing had been expended to the 30th June, 1880, and there had been no alteration in the condition of the channel to that date.

The sum of $25,421.01 was expended during the fiscal year ending

June 30, 1881, and the removal of about 80,000 cubic yards of material in place effected with an increase to the depth and width of the channel. No survey having been made at the close of the fiscal year, nothing more precise of the condition of the channel can now be stated.

During the fiscal year ending June 30, 1882, it is proposed to further increase the width and depth of the channel.

The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is $20,000; but owing to large and unexpected advances in the cost of dredging, since the first estimate was made, it is not unlikely that a further appropriation of $90,000 will be required.

The amount of commerce and navigation interested in this improvement is very great, though impossible to be furnished accurately, since it forms a part not easily separated from the rest of the commerce of the port of New York.

In a communication furnished by Messrs. J. P. & G. C. Robinson, June 29, 1880, and to be found in Report of Chief of Engineers for 1880, Part I, pages 506 and 507, it is stated that at five piers south of South Ferry, during the year 1879, there were 1,046 ships, barks, steamships, and brigs, besides canal boats and lighters. For the first quarter of 1880, there were reported 423 vessels. Just in the neighborhood there are immense store-houses and grain elevators. Messrs. Robinson also state that within a month or so of the time when they wrote, two large vessels were aground on the shoal.

July 1, 1880, amount available	$60,000 00	
Amount appropriated by act approved March 3, 1881	60,000 00	
		$120,000 00
July 1, 1880, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	25,421 00	
July 1, 1880, outstanding liabilities	5,600 00	
		31,021 00
July 1, 1881, amount available		88,979 00
Amount (estimated) required for completion of existing project		20,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		60,000 00

(See Appendix D 4.)

5. *Harlem River, New York.*—The survey of this work was directed by the act approved June 23, 1874, and on February 22, 1875, a report of the results of this survey, containing a project and estimate for the improvement of the river from Randall's Island to the Hudson River, was transmitted to Congress.

The commissioners appointed by the Supreme Court have not yet completed the work of acquiring the right of way for the proposed cut or canal to connect the Harlem and Hudson rivers. No operations have therefore been undertaken.

July 1, 1880, amount available	$400,000 00
July 1, 1881, amount available	400,000 00
Amount (estimated) required for completion of existing project	1,700,000 00

(See Appendix D 5.)

6. *Flushing Bay, New York.*—The original condition of the navigable channel was a depth at the shoalest part along the line leading to Flushing of 3.9 feet at mean low-water, and it was not therefore available for commerce.

The originally adopted project for the improvement was the formation of a tidal basin by means of dikes, which by its filling and emptying through one channel would keep up a depth of 6 feet at mean low-water, and even more, after once having been dredged. No modification has been made in the project.

The amount expended up to the close of the fiscal year ending June 30, 1880, was $11,941.89.

During that fiscal year but a portion, about 3,000 feet of diking, was constructed, which would have no decided effect upon the channel.

The amount expended during the year ending June 30, 1881, was $11,347.71 upon diking and dredging, and a narrow channel having a depth of 6 feet at mean low-water now communicates with the creek at Flushing.

The available balance, $14,291.74, will be devoted to widening the dredged channel and to diking.

The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is $128,500, but it is probable that the project may be completed for $75,000.

The amount of commerce and navigation to be benefited by the improvement is unknown. It is assumed that a development of trade by water would follow the improvement.

July 1, 1880, amount available	$15,639 45	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$25,639 45
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	6,816 23	
July 1, 1881, outstanding liabilities	4,531 48	
		11,347 74
July 1, 1881, amount available		14,291 74
Amount (estimated) required for completion of existing project		128,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		30,000 00

(See Appendix D 6.)

7. *Gowanus Bay, New York.*—The original condition of the channel was inadequate for the navigation of vessels employed in the commerce of this district, the depth of water varying from 6.9 feet to 12.3 feet at mean low-water.

The originally adopted plan was to dredge a channel from the 18-foot contour outside the bay to the drawbridge at Hamilton avenue; the estimated cost was $182,850; it has been recommended to the department to dredge the existing channel from Hamilton avenue to the southwest corner of Erie Basin and thence to divide it into two branches, one to the north and one to the south; the cost of this revised project will be $192,564.90.

There were no expenditures up to June 30, 1880; the condition remained unaltered at that time.

There were no expenditures for the year ending June 30, 1881. The amount available at that date will be devoted to dredging a channel from the 18-foot contour near the entrance to Erie Basin southerly to a point opposite Forty-sixth street.

The estimated sum required for the entire completion of the work of improvement in accordance with the approved and adopted project is $143,000, and for the proposed revised project $152,564.90.

Amount appropriated by act approved March 3, 1881	$40,000 00
July 1, 1881, amount available	40,000 00
Amount (estimated) required for completion of existing project	142,850 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	60,000 00

(See Appendix D 7.)

8. *Newtown Creek, New York.*—The original condition of the channel gave a depth of 12½ to 18 feet at mean low-water, which was insufficient for the large class of vessels frequenting the creek. The width was 240 feet. The original adopted project for the improvement was to dredge a channel about 200 feet wide and from 18 to 21 feet in depth, and no change has been made therein.

Nothing had been expended up to the close of the fiscal year ending June 30, 1880, and there has been no change in the condition of the creek to same date.

The amount expended during the year ending June 30, 1881, was $7,566.48, and the depth of the channel along the cut made is generally over 17 feet, with a minimum depth of 15½ feet.

The balance on hand, $2,433.52, will probably be expended during the year ending June 30, 1882, in removing bowlders and improving the cut already made.

The estimated amount for the entire completion of the work of improvement in accordance with the approved and adopted project would be $36,000 by a revised, and $26,250 by the original estimate.

The commerce of the creek is very large, and the amount of active business so great as to make it difficult to work upon the improvement.

July 1, 1880, amount available	$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	7,566 48
July 1, 1881, amount available	2,433 52
Amount (estimated) required for completion of existing project	26,250 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	36,000 00

(See Appendix D 8.)

9. *East Chester Creek, New York.*—The original condition of navigation was, between Town Dock and Lockwood's, a draught of less than 7 feet at high-water, through an intricate, crooked, and narrow channel south of Goose Island, rather more than 7 feet at high-water, and a dangerous reef of bowlders, &c., in close proximity to the course of vessels in passing the draw at Pelham Bridge.

The originally adopted project was for the making of a channel of 9 or 10 feet of draught at high-water from Town Dock to a point 3,000 feet above Lockwood's which included the construction, not yet undertaken, of a tidal basin above Lockwood's; to this has since been added the dredging of the channel west of Goose Island and the removal of the reef of bowlders, gravel, &c., just below Pelham Bridge.

The amount expended to the close of the fiscal year ending June 30, 1880, was $46,627.86.

At that date, from the absence of complaint, it was inferred, no surveys, however, having been made to test the fact, that the channels retained the depth of 9 or 10 feet at high-water.

During the fiscal year ending June 30, 1881, no expenditures have been made.

It may be necessary to rectify defects which a future examination may discover in portions of the channel already operated upon. Furthermore, until it is proved that a depth of 9 or 10 feet at high-water, deemed sufficient for the requirements of commerce in this locality, cannot be maintained under the scale of improvement already completed, it will be unnecessary to inaugurate new works.

The amount of funds available, $7,372.14, will be quite sufficient for the present wants of the case.

The amount necessary to be appropriated for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project, if entirely carried through as designed, is $82,500.

July 1, 1880, amount available	$7,372 14
July 1, 1881, amount available	7,372 14
Amount (estimated) required for completion of existing project	82,500 00

(See Appendix D 9.)

10. *Echo Harbor, near New Rochelle, New York.*—The original condition of navigation showed rocky obstructions, "Start Rock" and "Sheepshead Rock," the former exposed in part at low-water, and the latter with a minimum over it at mean low-water of 1 foot.

The originally adopted project was the removal of these rocks, the former to 6 feet at mean low-water and the latter at 9 feet. A change of project was made by increasing the depth of removal of Start Rock to 7 feet at mean low-water.

The amount expended to June 30, 1880, was $10,288.54.

The condition of the improvement was the removal of Start Rock to the depth of 7 feet at mean low-water.

The amount expended during the fiscal year ending June 30, 1881, was $98.93, and without change in the navigable condition of the harbor.

The amount available July 1, 1881, will be expended for the removal of a portion of Sheepshead Rock to the depth of 9 feet at mean low-water.

The estimated amount for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is $19,955.38.

From information furnished in December, 1875, it was stated that the tonnage of the port for the previous three years was 50,000 tons per annum, and the value of the commerce $1,500,000 per annum.

July 1, 1880, amount available	$5,711 46	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$8,711 46
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		98 83
July 1, 1881, amount available		8,612 63
Amount (estimated) required for completion of existing project		19,955 38
Amount that can be profitably expended in fiscal year ending June 30, 1883		13,000 00

(See Appendix D 10.)

11. *Harbor at New Rochelle, New York.*—The original condition of the channel was narrow and interspersed with sunken reefs of rocks which made it dangerous for navigation, and in the channel proposed to be excavated by dredging the depth varied from 0 to 8 feet at mean low-water.

The originally adopted project was to remove the rocky obstruction and dredge an inner channel between Hunter's and Flat Islands; the estimated cost was $40,825, and this project has not been modified.

There were no expenditures up to June 30, 1880, and the condition remained unaltered at that time.

The expenditures during the year ending June 30, 1881, $231.15, were for incidental purposes only, no work being done.

The amount available July 1, 1881, will be applied to the formation of a channel around Glen Island, by dredging and removing rock of the depth of 6 feet at mean low-water, and of the width of 100 feet.

The estimated sum required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is $20,825.

Amount appropriated by act approved March 3, 1881	$20,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	231 15
July 1, 1881, amount available	19,768 85
Amount (estimated) required for completion of existing project	20,825 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	19,000 00

(See Appendix D 11.)

12. *Port Chester Harbor, New York.*—In its original condition the channel was obstructed by "Sunken" and "Salt" Rocks, the former with a depth over it of 5.7 feet at mean low-water, the latter slightly projecting above the level of mean low-water.

The originally adopted project for the improvement was the removal of these rocks, and the construction of a breakwater. The amount expended to the close of the fiscal year ending June 30, 1880, was $10,050.

The condition of the improvement was the removal of Salt Rock to a depth of 9 feet at mean low-water, leaving "Sunken Rock," a dangerous obstruction, untouched.

There has been no expenditure for the year ending June 30, 1881.

. It is not proposed to expend anything during the fiscal year ending June 30, 1882, as the amount available, $1,950, is too small for operations.

The estimated amount required for the completion of the improvement of the harbor, according to the adopted and approved plan, is $84,632.

July 1, 1880, amount available	$1,950 00
July 1, 1881, amount available	1,950 00
Amount (estimated) required for completion of existing project	84,632 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	30,000 00

(See Appendix D 12.)

13. *Canarsie Bay, New York.*—The original condition of the channel leading to Canarsie answered to a depth of 4½ feet at mean low-water.

The originally adopted project was by the inclosure with dikes of a tidal basin, and no important amendments, alterations, or additions thereto have been made.

Nothing has been expended up to June 30, 1880, and the condition of the channel had not varied from its original status. During the fiscal year ending June 30, 1881, there have been expended $9,639.93; and the dike constructed—no examination as yet having been made since its completion, June 27, 1881—is reported to have deepened the water over the bar or shoal at the outlet of the channel.

The appropriation of March 3, 1881, will be reserved until by additional appropriation a sufficient sum becomes available for the construction of a line of sheet piling along the south edge of the channel at Canarsie with the object of collecting and concentrating the currents in that channel.

The estimated amount required for the entire and permanent completion of the work of improvement, in accordance with the approved and adopted project, is $73,000.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$15,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		9,639 93
July 1, 1881, amount available		5,360 07
Amount (estimated) required for completion of existing project		$73,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		9,000 00

(See Appendix D. 13.)

14. *Sheepshead Bay, New York.*—The original condition of the navigable channel was, for the entrance, a depth of little over 2 feet at mean low-water, and for the interior channel not less than 4 feet, except at two narrow bulkheads across said channel.

The originally adopted project, with a proviso, however, not to be commenced should the movement of Rockaway Inlet be likely to interfere, was to deepen the entrance by means of converging jetties, and to improve the interior channel by longitudinal dikes so placed as in some instances to form tidal reservoirs for the scour of the channel.

Nothing has been expended up to the close of the fiscal year ending June 30, 1880. The condition of things at the specified date was the same as that determined by the survey.

Nothing has been expended during the year ending June 30, 1881, and the state of things remains unaltered.

The amount of funds on hand is not sufficient for lasting improvement at any point, and therefore cannot be profitably expended prior to June 30, 1882.

The estimated amount for the entire and permanent completion of the work of improvement in accordance with the project approved and adopted (reserve being had of the probable movement of Rockaway Inlet) is $92,000.

July 1, 1880, amount available	$3,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$8,000 00
July 1, 1881, amount available		8,000 00
Amount (estimated) required for completion of existing project		92,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		10,000 00

(See Appendix D 14.)

15. *Sumpawaumus Inlet, New York.*—The original condition of the channel was, as to depth, from 1 to 5 feet, and as to width, from 30 to 600 feet.

The originally adopted project was to dredge a channel from 150 to 100 feet in width and 5 feet deep at mean low-water, and this project has not been modified.

Nothing has been expended up to June 30, 1880. The channel is in its original condition.

Nothing has been expended during the fiscal year ending June 30, 1881.

The amount available, $5,000, is insufficient for a beginning, as there would be required at least $15,000 to make a channel of the required depth and 60 feet in width, which is the least that would be of use for navigable purposes, and for that reason it cannot be profitably expended during the fiscal year ending June 30, 1882.

The estimated amount required to finish the project of improvement, as approved and adopted, is $18,115.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount available	5,000 00
Amount (estimated) required for completion of existing project	18,115 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	10,000 00

(See Appendix D 15.)

16. *Raritan River, New Jersey.*—The original condition of the navigation was an intricate channel at the "Stakes" of 7 feet at mean low-water, and of 6.1 feet on the "Middle Ground," and of 7 to 8 feet at mean low-water upon the other shoals as far up as New Brunswick.

The originally adopted project was to dike and dredge at the "Stakes" and "Middle Ground," and to remove other shoals up to New Brunswick, so as to make a channel 200 feet wide and 10 feet at least deep at mean low-water, and no modification has been made.

The amount expended to the close of the fiscal year ending June 30, 1880, was $233,453.43.

The condition of the improvement at that time was the completion of the dikes at the stakes and middle ground, except for a distance of 2,053 feet at the lower end; a channel at the "Stakes" everywhere over 12 feet deep at mean low-water (except for a short distance where it has been dredged only to 9 feet at mean low-water), has also been obtained. Dredging had also been done at the Middle Ground, but not sufficiently for a marked improvement in depth. A considerable amount of dredgings, bowlders, and rock was removed from the rocky shoal at Whitehead's sand dock.

There has been expended during the fiscal year ending June 30, 1881, the sum of $58,602.28. The diking has been completed at the "Stakes," dredging and rock-blasting at Whitehead's, and dredging on the Middle Ground. No surveys have been made, and the state of the channel at the Middle Ground and at Whitehead's is not known.

With the balance available July 1, 1881, a channel 12 feet deep at mean low-water through the Middle Ground, and of variable width and 12 feet in depth at White head's, will be excavated.

The estimated amount required for the entire and permanent completion of the work of improvement, in accordance with the approved and adopted project, is $1,708,662.

July 1, 1880, amount available	$100,000 00	
Amount appropriated by act approved March 3, 1881	25,000 00	
		$125,000 00
July 1, 1881, amount expended during the fiscal year, exclusive of outstanding liabilities July 1, 1880	32,055 71	
July 1, 1881, outstanding liabilities	22,678 41	
		54,734 12
July 1, 1881, amount available		70,265 88
Amount (estimated) required for completion of existing project		1,708,662 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		50,000 00

(See Appendix D 16.)

17. *South River, New Jersey.*—The original condition of the navigable channels is, first, a false direction of the canal mouth; a depth there at mean low-water of 3½ feet; thence up to Little Washington, depths varying from 3.1 to 11.6 feet at mean low-water; thence to Bissett's Brickyard, depths varying from 2.8 to 10.1 feet at mean low-water, and thence to Old Bridge, depths varying from 2.1 to 12.5 feet at mean low-water. There are also several sharp bends above Little Washington, where it will be expedient to straighten the course occasionally by cuts.

The originally adopted project, which has not been modified, was to change the outlet of the canal, to close the natural course of the river below Petit's, to dike and to dredge, in order to obtain 8 feet at mean low-water up to Little Washington; thence to straighten the course, dike and dredge up to Bissett's Brick-yard, in order to obtain 6 feet at mean low-water, and, finally, to straighten the course, dike and dredge to Old Bridge, in order to obtain 4 feet at mean low-water.

There were no expenditures up to June 30, 1880, and the condition remained unaltered up to that time.

The sum of $382.20 was expended during the fiscal year ending June 30, 1881. The condition of the river remained the same. With the amount available on June 30, 1881, it is proposed to construct a new outlet to the canal, to close the lower course of the river below Petit's, and to dike and dredge along the course of the canal.

The estimated amount for the entire and permanent completion of the work of improvement, in accordance with the approved and accepted project, is $148,695.

July 1, 1880, amount available	$40,000 00	
Amount appropriated by act approved March 3, 1881	6,000 00	
		$46,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		382 20
July 1, 1881, amount available		45,617 80
Amount (estimated) required for completion of existing project		148,695 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		20,000 00

(See Appendix D 17.)

18. *Cheesequakes Creek, New Jersey.*—The original condition of the channel over the bar or shoal at the mouth gives a depth of 1 foot at mean low-water; the channel in the creek has a depth of 4 feet at mean low-water for about ¾ of the length to be improved, and for the remaining portion a depth from 4 feet to 1½ feet at low-water. The course of the creek is very crooked, and requires to be straightened. The originally adopted project for the improvement was the change of the outlet into a direction at right angles to the beach; to sustain this direction by parallel jetties of stone, and to straighten the course of the creek and increase the depth in the upper portions thereof.

Nothing was expended to the close of the fiscal year ending June 30, 1880. The amount expended during the year ending June 30, 1881, was $129.82, and no alteration was made in the original condition of the outlet and creek.

The amount available can be profitably expended in changing the direction of the outlet, in closing the present outlet, and in a partial construction of the jetties at the mouth.

The estimated amount required for the entire and permanent completion of the work of improvement, in accordance with the approved and adopted project, is $50,279.

July 1, 1880, amount available	$20,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$25,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		129 82
July 1, 1881, amount available		24,870 18
Amount (estimated) required for completion of existing project		50,279 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		32,000 00

(See Appendix D 18.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with provisions of the river and harbor act of June 14, 1880, Colonel Newton was charged with and has completed the following, the results of which were duly transmitted to Congress and printed during the third session of the Forty-sixth Congress:

1. *New Rochelle Harbor, Westchester County, New York, from City Island to the town of New Rochelle.* House Ex. Doc. No. 71. (See Appendix D 11.)
2. *Bronx River, or West Farms Tide-water Creek, from its mouth in the city of New York.* House Ex. Doc. No. 54. (See Appendix D 19.)
3. *Hempstead Harbor in the State of New York.* House Ex. Doc. No. 48. (See Appendix D 20.)
4. *Sumpawaumus Inlet, Long Island, New York.* House Ex. Doc. No. 17. (See Appendix D 15.)
5. *Water-way connecting Jamaica Bay with Cornell's Landing, New York.* House Ex. Doc. No. 17. (See Appendix D 21.)
6. *Gowanus Bay, New York.* House Ex. Doc. No. 48. (See Appendix D 7.)
7. *Patchogue River, New York.* House Ex. Doc. No. 17. (See Appendix D 22.)

And to comply with provisions of the river and harbor act of March 3, 1881, he has been charged with *completing the survey of Harlem River and through the Harlem Kills to the East River*, the results of which will be duly submitted when received.

IMPROVEMENT OF RIVERS IN NORTHERN NEW JERSEY AND OF STATEN ISLAND CHANNEL AT ELIZABETHPORT — IMPROVEMENT OF HARBORS ON LAKE CHAMPLAIN, AND OF OTTER CREEK, VERMONT, AND TICONDEROGA RIVER, NEW YORK.

Officer in charge, Lieut. Col. N. Michler, Corps of Engineers.

1. *Passaic River, New Jersey, above Newark.*—The present project was adopted in 1872 and provides for the removal of rock and other obstructions between Newark and the head of navigation, so as to afford a sufficient channel 6 feet deep at mean low-water.

The amount expended to June 30, 1880, is $111,098.78, and has resulted in securing a 6-foot channel at mean low-water from the Midland Bridge to Passaic. During the summer of 1880 an old stone pier or abutment which greatly obstructed navigation was removed from the draw of the bridge of the New York, Lake Erie and Western Railroad, the railroad company having agreed to pay all expenses connected with the work. The boiler of the steam-drilling scow, heretofore in use on the river in removing bowlders and other obstructions, having become unserviceable, no further work was done during the fiscal year.

The appropriation of $9,924 asked is to be applied to the completion of the existing project.

July 1, 1880, amount available	$2,901 22
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	448 60
July 1, 1881, amount available	2,452 62
Amount (estimated) required for completion of existing project	9,924 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	10,000 00

(See Appendix E 1.)

2. *Passaic River, from Pennsylvania Railroad Bridge to its Mouth, New Jersey.*—The project for this improvement was adopted in 1880, and provides for the formation and maintenance of a channel 200 feet wide and 10 feet deep at mean low-water, from Pennsylvania Railroad Bridge to Newark Bay. The appropriation of $30,000 made by the river and harbor act of June 14, 1880, as far as expended, was applied to the construction of 2,002 linear feet of dike at the mouth of the river, and to the removal of 19,263 cubic yards of mud and sand. The appropriation of $50,000 made by the river and harbor act of March 3, 1881, will be applied to completing the dike at the mouth of the river, and to widening and extending the 10-foot channel by means of dredging as far up stream as the funds available will permit.

The appropriation of $100,000 asked for is to be applied to continuing the existing project.

July 1, 1880, amount available	$30,000 00	
Amount appropriated by act approved March 3, 1881	50,000 00	
		$80,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	21,665 57	
July 1, 1881, outstanding liabilities	2,677 56	
		24,343 13
July 1, 1881, amount available		55,656 87
Amount (estimated) required for completion of existing project		152,875 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		100,000 00

(See Appendix E 2.)

3. *Channel between Staten Island and New Jersey at Elizabethport.*—A project for this improvement providing for the formation of a channel 15 feet in depth at mean low-water, was approved in 1873, and subsequently modified by a Board of Engineers in 1875.

At a later period a plan of improvement, modified in accordance with the changed requirements of the commerce of Elizabeth, was submitted by the local engineer. In accordance with this plan, a project for the application of the appropriation of $29,000 made by the river and harbor act of June 14, 1880, together with the balance remaining from previous appropriations, was submitted by the officer in charge June 28, 1880, and referred to the Board of Engineers for Fortifications and for River and Harbor Improvements, which board modified the plan so as to provide for a channel 400 feet in width and 12 feet in depth at mean low-water. Dredging to an additional depth of 1 foot is also proposed for a portion of the width, so as to afford a depth of 13 feet over a width of 200 feet, the line of cutting to follow the general direction of the present channel.

A contract was entered into to dredge the channel in accordance with this plan. Operations were continued, with interruption during the winter on account of floating ice, to the close of the fiscal year. During this period 101,368 cubic yards of material were removed, resulting in the formation of a channel 13 feet deep at mean low-water, and from 50 to 200 feet wide, extending from the deep water to the east of Shooter's Island to a point 700 yards to the west of the Corner Stake Light. The least depth in the channel before the dredging operations were commenced was 10.3 feet.

It is proposed to apply the appropriation of $75,000 asked for to continue the dredging in accordance with the existing plan.

July 1, 1880, amount available		$52,006 37
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$18,061 90	
July 1, 1881, outstanding liabilities	5,405 63	
		23,467 53
July 1, 1881, amount available		28,538 84
Amount (estimated) required for completion of existing project		133,698 63
Amount that can be profitably expended in fiscal year ending June 30, 1883.		75,000 00

(See Appendix E 3.)

4. *Shrewsbury River, New Jersey.*—The present project was adopted in 1879, and provides for the formation of a channel 6 feet in depth at mean low-water from the entrance of the Shrewsbury River to Upper Rocky Point, on the North Branch, and to Jumping Point on the South Branch. The depth in the natural channels was not more than 3½ feet at their shoalest points. Up to the close of the fiscal year ending June 30, 1880, $43,797.52 had been expended. The crib and training dikes at the junction of the North and South Branches were nearly completed, and the channel around Lower Rocky Point dredged to a depth of 6 feet at mean low-water.

In August, 1880, a modification of the existing project was adopted as far as it related to the portion of the river fronting along the town of Seabright above the bridge. The modified project contemplates the improvement of the east, or Seabright Channel, instead of the west, or Jumping Point Channel, as originally provided. During the fiscal year ending June 30, 1881, a cut 6 feet deep and 90 feet wide was dredged through the flat at the mouth of the South Branch, and the dike at the entrance to Pleasure Bay was constructed. On the North Branch dredging operations were carried on between Lower Rocky Point and Barley Point, in the formation of the direct channel to Oceanic Dock. At the close of the fiscal year the 6-foot depth had been carried up stream to above Upper Rocky Point.

The appropriation of $47,000 asked for is to be applied to the completion of the modified project.

July 1, 1880, amount available	$34,702 48	
Amount appropriated by act approved March 3, 1881	86,000 00	
		$120,702 48
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	15,073 11	
July 1, 1881, outstanding liabilities	8,215 60	
		23,288 71
July 1, 1881, amount available		97,413 77
Amount (estimated) required for completion of existing project		47,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		47,000 00

(See Appendix E 4.)

5. *Rahway River, New Jersey.*—The present project was adopted in 1878, and contemplates a channel of 8 feet in depth and varying in width from 100 to 125 feet from "Bricktown" up to Main Street Bridge at the head of navigation. During the fall of 1879, 2,733 cubic yards of material were dredged from the channel in the vicinity of Edgar's Dock. The contractor having failed to resume work, his contract was annulled.

The appropriation made June 14, 1880, was combined with the unexpended balance from previous appropriations, and a new contract entered into for the continuance of the work. Operations under the latter were commenced in April and continued to the close of the year, resulting in the formation of a channel from 25 to 70 feet wide and 7 feet deep from Edgar's Dock to Tappan's Dock, about 600 feet below Milton Avenue Bridge.

The depth in the natural channel before dredging was 4.5 feet.

The amount expended to June 30, 1880, was $2,108.26.

The appropriation of $10,000 made by the act of March 3, 1881, will be applied to continuing the existing project, for the completion of which an additional appropriation of $7,000 is asked.

July 1, 1880, amount available	$17,891 74	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$27,891 74
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	5,532 44	
July 1, 1881, outstanding liabilities	2,861 76	
		8,394 20
July 1, 1881, amount available		19,497 54
Amount (estimated) required for completion of existing project		7,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		7,000 00

(See Appendix E 5.)

6. *Elizabeth River, New Jersey.*—The improvement of this river was commenced in 1879, in accordance with the authorized project, which contemplates the formation of a channel 60 feet wide, and not less than 7 feet deep, at mean high-water, from the mouth of the river to the head of navigation, terminating at the Stone Bridge near the Broad Street Crossing.

During the past year the appropriation of $7,500, made by the river and harbor act of June 14, 1880, together with the balance remaining on hand, was expended in removing 9,200 cubic yards of sand, mud, and clay from the channel; the 7-foot depth being extended up stream to about 150 feet below South Street Bridge, 5,300 feet above the point at which dredging was first begun. The depth available in the natural channel before dredging was 4½ feet. It is proposed to apply the appropriation of March 3, 1881, to continuing the 7-foot channel up stream as far as the available funds will admit. The amount expended to June 30, 1880, was $5,544.31.

The appropriation of $24,160 asked is for the completion of the existing project. This increase of the original estimate for completion is due to the great advance in the price of material and labor.

July 1, 1880, amount available	$9,455 69	
Amount appropriated by act approved March 3, 1881	4,000 00	
		$13,455 69
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		9,505 53
July 1, 1881, amount available		3,950 16
Amount (estimated) required for completion of existing project		24,160 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		24,000 00

(See Appendix E 6.)

7. *Woodbridge Creek, New Jersey.*—The present project was adopted in 1878, and contemplates the formation of a channel 80 feet wide and 12 feet deep at mean high-water. The appropriation of $4,000 for the fiscal year ending June 30, 1880, was expended upon the upper part of the river in widening the stream near the Salamander Dock; dredging a cut through the shoal above Valentine's Dock 80 feet wide and 9 feet deep at high-water; and constructing a pile revetment for the purpose

of straightening and strengthening the banks in the latter vicinity. By the river and harbor act of June 14, 1880, $5,000 was appropriated to continue the improvement, which was applied to dredging a cut through the bar at the mouth of the creek connecting the 12-foot curve of Staten Island Sound with the 12-foot curve of the creek above the first bend. This cut is 80 feet wide as far up stream as Boynton's Dock, above which point it gradually diminishes to a width of 20 feet. The least depth on the shoal above Valentine's Dock before dredging was 6½ feet, and the least depth in the channel across the bar before dredging was 9½ feet.

The amount expended up to the close of the fiscal year ending June 30, 1880, was $3,823.01.

The increase of the original estimate for completion is due to the great advance in the price of material and labor.

July 1, 1880, amount available	$5,176 99	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$10,176 99
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		4,914 72
July 1, 1881, amount available		5,262 27
Amount (estimated) required for completion of existing project		9,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		9,000 00

(See Appendix E 7.)

8. *Manasquan River, New Jersey.*—By the river and harbor act of March 3, 1879, an appropriation of $12,000 was made for this work, and a project for improvement adopted. A contract was entered into for carrying on this project, but owing to the failure of the contractor to commence operations, no work was done during the fiscal year ending June 30, 1880, and the contract was annulled.

The river and harbor act of June 14, 1880, appropriated an additional sum of $20,000. This was combined with the balance of the former appropriation, and a contract entered into for carrying on the improvement in accordance with a revised project submitted by the engineer in charge, viz: "The opening of a direct channel-way across the beach, and protecting the same for the flow of the tidal currents between the river and the ocean, so as obtain and maintain a suitable depth for the passage of similar vessels to those now employed on the basins of the river above its mouth, and for coasters of light draught." Operations on the construction of the north jetty were begun on June 17, 1880, and are still in progress. Up to the close of the fiscal year ending June 30, 1881, the piling of about 500 feet of the north jetty had been driven.

The amount expended to June 30, 1880, was $1,341.55.

The appropriation of $21,000 asked is for the completion of the existing project.

July 1, 1880, amount available	$30,658 45
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,076 54
July 1, 1881, amount available	28,581 91
Amount (estimated) required for completion of existing project	21,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	21,000 00

(See Appendix E 8.)

9. *Raritan Bay, New Jersey.*—The appropriation made by the act of March 3, 1881, for this work, not being available until near the close of the fiscal year, no work has been done.

The present project was adopted in 1880, the object being to afford a channel 300 feet in width and 21 feet in depth at mean low-water, to connect the deep water to the west of Sequine Point leading to the Amboys. The appropriation of $76,500 asked for is to be applied to the completion of the existing project.

Amount appropriated by act approved March 3, 1881	$50,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	315 68
July 1, 1881, amount available	49,684 32
Amount (estimated) required for completion of existing project	76,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	76,500 00

(See Appendix E 9.)

10. *Mattawan Creek, New Jersey.*—The appropriation made by the act of March 3, 1881, for this work not being available until near the close of the fiscal year, no work has been done.

The present project was adopted in 1881, the object being to afford a channel of navigable width and of not less than 4 feet deep, from the entrance at Keyport to the head of navigation at the crossing of the New York and Long Branch Railroad Bridge.

The appropriation of $18,120 asked for is to be applied to the completion of the existing project.

Amount appropriated by act approved March 3, 1881	$15,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	267 28
July 1, 1881, amount available	14,732 72
Amount (estimated) required for completion of existing project	18,120 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	18,000 00

(See Appendix E 10.)

11. *Plattsburgh Harbor, New York.*—The present project was adopted in 1870, and is for the extension of the breakwater 400 linear feet, the revetment of the United States land, and the dredging of shoals of periodical formation.

The amount expended under this project up to June 30, 1880, was $49,120.09, which was applied to the extension of the breakwater 400 feet, and to dredging of shoals along the faces of wharves lying nearest the breakwater, and along the approach of the slip, and of the sand-bar at the southeast corner of the south wharf.

The appropriation of $5,000 asked for is to be applied to dredging.

July 1, 1880, amount available	$3,879 91
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,107 58
July 1, 1881, amount available	1,772 33
Amount that can be profitably expended in fiscal year ending June 30, 1883.	5,000 00

(See Appendix E 11.)

12. *Burlington Harbor, Vermont.*—The present project was adopted in 1874, and provided for the protection of the harbor by the extension of the breakwater 2,000 linear feet in a northwesterly direction. The amount expended under this project to June 30, 1880, was $72,704.53. The entire length of the breakwater, including 70 feet in process of construction, is 3,214 feet. The appropriation of $40,000 asked for is for

the continuation of the extension of the breakwater in a northwesterly direction.

July 1, 1880, amount available	$17,295 53	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$27,295 53
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		13,504 19
July 1, 1881, amount available		13,791 34
Amount (estimated) required for completion of existing project		240,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		40,000 00

(See Appendix E 12.)

13. *Swanton Harbor, Vermont.*—The project for the protection of this harbor by the construction of a breakwater, 1,900 feet in length, was adopted in 1873.

The amount expended on this work to June 30, 1880, was $57,864.08, and has resulted in the construction of a line of breakwater 259 feet in length, comprising three cribs. During the year the work of widening the foundation of the breakwater by rubble stone has been completed. With the funds available it is proposed to complete the repair of the breakwater.

The appropriation of $15,000 asked for is to be applied to the extension of the breakwater in a northwesterly direction.

July 1, 1880, amount available	$5,635 92	
Amount appropriated by act approved March 3, 1881	2,500 00	
		$8,135 92
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		1,787 66
July 1, 1881, amount available		6,348 26
Amount (estimated) required for completion of existing project		174,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		15,000 00

(See Appendix E 13.)

14. *Otter Creek Vermont.*—The present project for the improvement of this creek was adopted in 1871, and contemplates the removal of various snags, shoals, and other obstructions from the bed of the stream, and the deepening of the basin of Vergennes, so as to afford a depth of 8 feet between Vergennes and Lake Champlain.

The amount expended on this work to June 30, 1880, was $21,869.35, and has resulted in the improvement of those portions of the creek and basin most troublesome to its navigation.

The appropriation of $5,000 asked for is to be applied to the improvement of the basin and channel by dredging and removing such obstructions as have become lodged in them.

July 1, 1880, amount available	$8,130 65	
Amount appropriated by act approved March 3, 1881	2,000 00	
		$10,130 65
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		1,699 74
July 1, 1881, amount available		8,430 91
Amount (estimated) required for completion of existing project		26,146 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		5,000, 00

(See Appendix E 14.)

15. *Ticonderoga River, New York.*—The present project was adopted in 1881, the object being to dredge a channel from the railroad bridge

extending eastwardly to the 8-foot curve in Lake Champlain, and to improve the channel from the railroad bridge to the foot of the falls.

The appropriation for this work not having been made available till near the close of the fiscal year, no work has been done.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	34 35
July 1, 1881, amount available	4,965 45
Amount (estimated) required for completion of existing project	37,516 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	10,000 00

(See Appendix E 15.)

16. *Removal of the wreck of the bark Samarang, New York Harbor.*—The Board of Commissioners of Pilots of the city of New York having made representations, November 16, 1880, that the wreck of a vessel, the bark Samarang, sunk off Sandy Hook Bar, was in a position dangerous to vessels navigating the South Channel into New York Harbor, the Secretary of War, in conformity with the provisions of section 4 of the river and harbor act of June 14, 1880, directed that the necessary steps should be taken for its removal.

After due notice, given in accordance with the requirements of the above act of Congress, a contract was made with the Atlantic Dredging Company for the removal of the wreck.

In February the contractor's plant was taken to the buoy placed to mark the wreck by the naval inspector of the third light-house district, but an attempt to find it had to be abandoned, owing to stormy weather and the quantity of drift ice. Subsequently an examination showed that no part of the wreck could be found, and that in all probability it had been broken up by the sea and the fragments dispersed.

It is believed that no portion of the wreck has lodged in any of the channels leading into the harbor.

(See Appendix E 16.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with provisions of the river and harbor act of June 14, 1880, Lieutenant-Colonel Michler was charged with and completed the following:

1. *Mattawan Creek, from Raritan Bay Channel to Central Railroad bridge, head of navigation.* (See Appendix E 10.)
2. *Ticonderoga River, New York.* (See Appendix E 15.)
3. *Shark River, New Jersey.* (See Appendix E 17.)
4. *Perth and South Amboy to main ship channel off Great Kills, Raritan Bay.* (See Appendix E 9.)

The above have been transmitted to Congress and printed as House Ex. Doc. No. 45, Forty-sixth Congress, third session.

And the following, for which provision is made in the river and harbor act of March 3, 1881, which had been assigned to Lieutenant-Colonel Michler, have since his decease, July 17, 1881, been transferred to his successor, and their results will be duly submitted when received.

1. *Harbor at Port Henry on Lake Champlain.*
2. *Channel between islands of North Hero and South Hero, Lake Champlain.*
3. *From a point between Ellis Island and the docks of New Jersey Central Railroad to a point between Robbin's Reef Light and Constable Hook, in waters of New York Bay, New Jersey.*

IMPROVEMENT OF DELAWARE AND SCHUYLKILL RIVERS; OF THE SUSQUEHANNA, ABOVE RICHARD'S ISLAND, AND RIVERS IN NEW JERSEY AND DELAWARE—HARBOR IMPROVEMENTS IN DELAWARE RIVER AND BAY—CONSTRUCTION OF PIER AT LEWES—DELAWARE BREAKWATER.

Officer in charge, Col. J. N. Macomb, Corps of Engineers, with Capt. William Ludlow, Corps of Engineers, under his immediate orders.

1. *Delaware River between Trenton, New Jersey, and Bridesburg, Pennsylvania.*—The improvement of the eastern channel of the Delaware, past Bordentown, was continued during the fiscal year. On June 30, the 7-foot low-water channel from the canal entrance to Duck Island had been completed within about 800 feet.

The bed of the Delaware in this vicinity is sand, which is readily acted upon by the currents; in consequence, the results of the dredging cannot be anticipated with certainty, and the officer in charge again suggests the necessity of some permanent works to direct the flow into the improved channel.

In consequence of the severe winter, two ice-gorges formed within 3 miles of Bordentown. That caused a flow of water and heavy ice over the dikes constructed in 1879, injuring them to some extent. Repairs were made with a portion of the $10,000 appropriated in act of March 3, 1881.

With the balance dredging operations will be continued, with the expectation of opening the 7-foot channel through. For the maintenance of this channel, the construction of a deflecting dike from the western shore, and the dredging necessary at Kincora and Periwig bars, an appropriation of $25,000 can be profitably expended during the fiscal year 1882–'83.

July 1, 1880, amount available	$10,002 42	
Amount appropriated by act of March 3, 1881	10,000 00	
		$20,002 42
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	9,995 38	
July 1, 1881, outstanding liabilities	323 63	
		10,319 01
July 1, amount available		9,683 41
Amount that can be profitably expended in fiscal year ending June 30, 1883.		25,000 00

(See Appendix F 1.)

2. *Delaware River, below Bridesburg, Pennsylvania.*—Operations for the removal of the main obstructions to the free navigation of the Delaware River between Bridesburg and the head of Delaware Bay have progressed during the last fiscal year.

For the relief of the up-river navigation past Five-mile Point, a 9-foot low-water channel following the line of existing deepest water was dredged through the shoal in that vicinity. It was not anticipated that the relief would be more than temporary, and further expenditure would not be judicious, unless sufficient to affect the regimen of the stream. Another channel past the upper end of Petty's Island, exhibiting much more favorable conditions and indications of permanency, has been selected for improvement during the ensuing season. The bulkhead obstructing the main ship-channel in the vicinity of Petty's Island, opposite Richmond, Philadelphia, was reported last year as having been cut through with a 24-foot low-water channel of 100 feet in width.

This width has been increased to 225 feet, and the widening will be continued, the large traffic due to the heavy shipments of coal and grain demanding greater accommodation.

The cross-river navigation between Camden and Philadelphia, as well as the use of the broad channel east of Smith's Island, is impeded by bars abutting on that island. In particular, the up-stream shoal nearly unites with one reaching down from the lower end of Petty's Island; a 10-foot channel was made through this in a direction as nearly as possible parallel with the tidal currents, without much expectation of permanency; the results, however, were more favorable than was anticipated, and during the ensuing season this channel will be widened to 400 feet, with the hope that the eastern channel of the Delaware may be made available for the lighter class of vessels and relieve the deep and narrow channel between Smith's Island and Philadelphia of considerable pressure.

Operations for the deepening of the cut across Mifflin Bar have not been satisfactory. In 1879, after vigorous work with two powerful dredges, there existed a channel depth exceeding 26 feet at low-water. During the fiscal year 1879–'80, notwithstanding dredging was continued, the channel shoaled to 24 feet in consequence of the insufficient capacity of the machine used. During the last fiscal year this depth has decreased to 22 feet, by reason of the contractor's tardiness in securing a suitable place of deposit, and the inability of the dredge to operate successfully at such deep work and in a strong tide.

Experience on this work proves conclusively that no valuable results can be attained except by such rapid prosecution of the work as shall outstrip the accumulations due to transportation of silt along the bottom and make the tidal currents auxiliaries. The construction of permanent works for the maintenance of this artificial channel has been considered, but the necessity for them should be positively shown before the considerable expense involved is undertaken.

During the ensuing fiscal year operations under the existing contract will be continued by an extension of time for completion to September 30, 1881, and thereafter, with $45,000 of the appropriation of March 3, 1881, an effort will be made to restore the depth to 26 feet, and observe the result.

There were no expenditures at Bulkhead Shoals, owing to the insufficient appropriation. The channel continues narrow, with available low-water depth of about 22 feet. The frequent grounding and delay are the occasion of great complaint. It is proposed, with a reserved allotment from the appropriation of June 14, 1880, and a further amount derived from that of March 3, 1881, to expend about $40,000 in deepening the channel to 24 feet, to as great a width as may be practicable.

Between Reedy Island and Liston's Point the shores separate and the river expands into the bay. The Dan Baker Shoals occupy the space, with channel depths of 22 or 23 feet at low-water across them. No expenditures have heretofore been made for the improvement of the navigation through these shoals, and none are in contemplation, for lack of funds. To connect the 24-foot low-water curves above and below them a channel must be dredged with a length of 1,800 yards, width of 300 yards, and average depth of cutting of 1 yard. Frequent representations have been received of the obstructions in this vicinity, which the increasing dimensions of ships directly and largely augment. An appropriation of $50,000 is recommended for beginning operations.

The difficulties incident to the navigation of the "Horse Shoe," which are considerable in summer, owing to the deep curvature of the channel and the existence of broad shoals on both borders, are immensely aggravated in winter by the gorging of ice.

Between Gloucester and Eagle Point the river widens, and ice filling the enlargement has but limited means of escape. Measures for the improvement of this portion of the river have been heretofore recommended and the consideration of the subject will be renewed.

The provision of harbors suitable for the security of the winter navigation is a subject of great importance on the Delaware River. The existing useful harbors are two in number, viz, at Marcus Hook and New Castle, the former in process of enlargement and the latter of completion according to the present design.

Great need exists for the construction of a capacious harbor near the head of Delaware Bay, and the act of June 14, 1880, directed that a survey be made for the purpose of locating it.

The Engineer officer in charge renews his recommendation, in which I concur, for the legal authorization to appoint harbor masters to regulate the use of the sheltered areas and prevent abuses, under such regulations as may be approved by the Secretary of War.

The chart of the Delaware from Liston's Point to League Island, under two orders of Congress, has been completed. A desirable and useful extension of this would include the tidal section between Philadelphia and Trenton.

During the past year the system of disposing of all dredgings in conformity with existing salutary State laws of Pennsylvania and New Jersey, has been continued to the advantage of the navigation.

July 1, 1880, amount available	$88,525 31	
Amount appropriated by act approved March 3, 1881	100,000 00	
		$188,525 31
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	43,403 54	
July 1, 1881, outstanding liabilities	2,883 99	
		46,287 53
July 1, 1881, amount available		142,237 78
Amount that can be profitably expended in fiscal year ending June 30, 1883.		150,000 00

(See Appendix F 2.)

3. *Delaware River, at Schooner Ledge.*—The removal of the reef in the channel of the river at this point has progressed satisfactorily during the past year.

The width of 24 feet deep at mean low-water has been increased from the original 45 feet least width in 1879, before work was commenced, to 90 feet in 1880 and 150 feet in 1881 (by the removal of parallel strips), with the probability that it will be 185 feet on or before December 1 of this year, and at least 220 feet by the end of the fiscal year 1881–'82, when the removal of the heaviest cutting in rock will have been effected, after the expenditure of all sums now available.

Isolated peaks of ledge, projecting 3 to 5 feet above the 24-foot plane, and heretofore unreported by pilots and ship-masters, have been discovered in the old 24-foot channel, west of the principal reef. One of these was the occasion of serious accident during the year, and has been blasted off. Another group of less height is known to exist and will be removed. Nothing short of the complete obliteration of the reef and of the minor, though not less dangerous, peaks in the neighborhood can prevent frequent accident and satisfy the demands for safe navigation.

The reports show that the cost of the work has been very nearly as originally estimated, viz, $25 per cubic yard.

The amount of appropriation for 1882–'83 should not be less than the balance of original estimate, viz, $97,000, in one sum, so that contract favorable to the United States can be effected.

The present knowledge of the river bed, as derived from recent minute examination, renders it evident that the scope of operations will have to be extended beyond the field of original project. The examination of the bed will be proceeded with, and the probable cost of removal of projecting rock or lumps can be stated in the Annual Report for 1882. The commerce to be benefited is nearly the whole ocean commerce of the Delaware.

July 1, 1880, amount available	$55,558 59	
Amount appropriated by act approved March 3, 1881	40,000 00	
		$95,558 59
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		17,346 28
July 1, 1881, amount available		78,212 31
Amount (estimated) required for completion of existing project		97,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		97,000 00

(See Appendix F 3.)

4. *Delaware River, near Cherry Island Flats.*—The construction of the channel, 24 feet deep at low-water and 900 feet in width through the Cherry Island Flats, has been in progress for the past two years. On June 30, 1880, the width attained was 110 feet, and during the fiscal year just closed this width has been increased to 270 feet. Operations continuing under present contract and one to be made under appropriation of March 3, 1881, it is expected that the width in August, 1882, will be 495 feet.

It has been found necessary to revise the original estimate of the cost of this improvement.

The chart of 1878, upon which the project was planned and the estimate based, appears to have been referred to an assumed plane of mean low-water about 1½ feet higher than the actual one derived from observations. The result is that 1½ feet additional of excavation are required over the whole area, and the distance over which dredging is needed to attain 24 feet at low-water is considerably increased.

The action of the currents upon the newly-exposed bed and margins of the dredged channel has, on the whole, been favorable, although the effects are seen rather in an excavation of the bottom than in a marked widening of the channel. In consequence, shoals have formed from time to time in the new channel and been removed by redredging.

In all such cases as this of an artificial channel through banks of mud and sand, great caution is required in the statement of results to be anticipated. It is thought probable, however, that with the additional amount called for in the revised estimate, and the habitual use of the new channel by all steamers, it can be constructed to the width of 900 feet, and will exhibit a tendency to maintain its depth.

At present the occupation of the insufficient width by the contractor's dredging plant interferes with its free use by steamers. During the winter, the plant being absent, the use of the channel became general, to the great advantage of navigation.

July 1, 1880, amount available	$123,952 86	
Amount appropriated by act approved March 3, 1881	100,000 00	
		$223,952 86
July 1, 1884, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	79,880 54	
July 1, 1881, outstanding liabilities	18,360 74	
		98,241 28
July 1, 1881, amount available		125,711 58
Amount (estimated) required for completion of existing project (revised)		222,720 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		136,000 00

(See Appendix F 4.)

5. *Schuylkill River, Pennsylvania.*—The existing contract for the improvement of the Schuylkill River is directed to the attainment of a channel 24 feet deep at mean low-water, and 250 feet wide, from the confluence with the Delaware upwards to Penrose Ferry Bridge, and a continuance of the channel 20 feet deep and 175 feet wide thence to "Gibson's."

Work has not proceeded satisfactorily upon this contract the past season, owing to the early and long-continued winter, combined with the delay of the contractor in providing a suitable place of deposit, and the time for completion has been extended from July 1 to September 30, 1881.

The appropriation of March 3, 1881, will be expended in pursuance of the same project. These dimensions, however, are quite inadequate to the accommodation of the heavy traffic of the Schuylkill, and it has been in contemplation to prepare a new project, having greater depths and widths in view. The determination of the Port Warden's lines, defining the position, character, and limits of extension of structures upon both banks of this narrow but valuable stream, has so important a bearing upon the present improvement of the navigation that the final adoption of such lines should precede the preparation of the improved project. The local authorities, aided by an advisory commission of United States officers, have the subject under consideration, and it is hoped that a decision will have been finally reached in time to admit of preparation of a new project during the ensuing winter.

Resurveys of the hydrography of the Schuylkill, from Yankee Point downwards to the confluence with the Delaware, have been made the past year.

July 1, 1880, amount available	$40,001 21	
Amount appropriated by act approved March 3, 1881	40,000 00	
		$80,001 21
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,675 42
July 1, 1881, amount available		77,325 79
Amount that can be profitably expended in fiscal year ending June 30, 1883		50,000 00

(See Appendix F 5.)

6. *Ice Harbor at Marcus Hook, Pennsylvania.*—Since 1871 this harbor has consisted of four detached stone piers and two wooden landing piers, inclosing about 4 acres.

These dimensions proving inadequate to the protection of the increasing commerce, the act of March 3, 1879, called for an examination and project for enlargement. In the report of the results of this examination which was transmitted to Congress, the cost was estimated at $90,000. The river and harbor act of June 14, 1880, appropriated $35,000, and that of March 3, 1881, a further sum of $30,000.

During the past fiscal year two additional ice-piers on a third line have been put under contract, and will be completed in September, 1881. The effect of these will be to double the protected area.

In addition to the construction of the piers, the original project called for a considerable amount of dredging shoreward between the landing piers, by which theavailable area would be increased to about 14 acres.

After further study of the subject, the engineer officer in charge proposes to submit an amended project, which, at an expense of $8,000 in excess of the former estimate, will enlarge the harbor to over 18 acres, which it is believed will be sufficient for many years to come.

The officer in charge urges the necessity of supervision during the ice season, in order to prevent abuse of the benefits of the harbor, and recommends the authorization of appointment of harbor-masters.

July 1, 1880, amount available	$35,000 00	
Amount appropriated by act approved March 3, 1881	30,000 00	
		$65,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities	3,826 09	
July 1, 1881, outstanding liabilities	20,495 00	
		24,321 09
July 1, 1881, amount available		40,678 91
Amount (estimated) required for completion of existing project		33,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		25,000 00

(See Appendix F 6.)

7. *Ice Harbor at Chester, Pennsylvania.*—On account of its limited accommodations, the impracticability of increasing its available area, and the necessary yearly expense of repairing the wooden piers and bridges, it is proposed to abandon this harbor so soon as adequate provision for its original purpose shall have been effected by the enlargement now in progress of the neighboring harbor at Marcus Hook.

July 1, 1880, amount available	$82 24
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	50 00
July 1, 1881, amount available	32 24

(See Appendix F 7.)

8. *Ice Harbor at New Castle, Delaware.*—Until the construction of the proposed harbor at the head of Delaware Bay shall have so far advanced as to afford shelter, the New Castle Harbor is the most important and valuable one in the river.

The act of March 3, 1881, appropriated $20,000 for the construction of the additional pier needed to complete the design of the harbor, and the work was put under contract in July, 1881.

An additional appropriation of $3,000 is needed to complete the dredging of the harbor, after which it should remain in an efficient condition for many years.

During the winter two of the ice-piers were struck and injured by badly-handled vessels. The necessary repairs will be made during the present season.

The contract calls for the completion of the new pier before January 1, 1882.

The limited dimensions of the harbor as compared with the large number of vessels seeking its protection in the ice season renders supervision and control by an authorized harbor-master especially desirable.

July 1, 1880, amount available	$3,739 76	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$23,739 76
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	86 51	
July 1, 1881, outstanding liabilities	86 61	
		173 12
July 1, 1881, amount available		23,566 64
Amount (estimated) required for completion of existing project		3,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		3,000 00

(See Appendix F 8.)

9. *Wilmington Harbor, Delaware.*—The project for the attainment of a 12-foot low-water navigation in the Christiana River, which is the harbor of Wilmington, Del., has been in progress since 1871, and was completed during the fiscal year by the application of the $10,000 appropriated June 14, 1880, to deepening the channel of entrance from 9 feet to 13 feet at low-water. The cost of the improvement has been $83,500, and corresponded closely with the estimate.

The act of June 14, 1880, directed a survey to be made from the Delaware Railroad Bridge to the mouth, and plans and estimates to be submitted of the cost of deepening the navigation to 15 feet at low-water.

The survey has been completed. It shows the existence of a 12-foot low-water navigation to the city, and that about 42 per cent. of the channel length has a low-water depth of 15 feet and over. The estimate for the proposed deepening was $175,551.

The conditions appear favorable, with the exception of the mud bar in the Delaware outside the Christiana entrance, and the deposits of sewage from the city of Wilmington. A jetty will be built to correct the former defect, and the necessary works are in course of construction by the city to protect the river from the deposits of solid matters.

The appropriation of March 3, 1881, will be expended during the ensuing year in the construction of the jetty at the entrance, and the extension of the existing 12-foot navigation as far as the Pulp Works, preliminary to beginning operation on the 15-foot navigation.

An appropriation of $50,000 will be required for the continuation of the project during the fiscal year 1882–'83.

July 1, 1880, amount available	$10,672 36	
Amount appropriated by act approved March 3, 1881	50,000 00	
		$60,672 36
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		10,828 44
July 1, 1881, amount available		49,843 92
Amount (estimated) required for completion of existing project		125,551 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		50,000 00

(See Appendix F 9.)

10. *Broadkiln River, Delaware.*—An appropriation of $10,000 for this improvement was made in 1873, and expended in removing shoals in the river.

The desirability of increasing the depth of entrance was noted and estimates therefor submitted, amounting to $30,000.

No further appropriation was made until that of June 14, 1880, of $5,000, to which the act of March 3, 1881, added another $5,000.

In pursuance of an examination made during the last fiscal year a project has been prepared by the engineer officer in charge for the construction of a jetty and the necessary dredging at the entrance, the cost of which to reach 6 feet at low-water in the bay was $41,000. For the improvement of the river proper a further sum of about $10,450 would be needed.

The total estimate is, therefore, $51,450. The cost of improving the entrance can be reduced temporarily (with the understanding, however, that ultimately the entire amount will be required) by terminating the jetty at the low-water mark and dredging to 5 feet instead of 6.

The anticipated effect of these partial works is to increase the entrance depth from 1 foot, which it now is, to 3 or 3½ feet, at a cost of $25,000.

The present balance to the credit of the works is $9,000, which, deducted from $25,000, leaves a balance of $16,000 needed to complete the partial project. An amount less than this would effect no useful result towards improving the entrance; neither can the amount now available be applied to any useful purpose.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		1,022 42
July 1, 1881, amount available		8,977 58
Amount (estimated) required for completion of existing project		41,500 00
Amount that can be profitably expended in fiscal year ending June 30 1883.		16,000 00

(See Appendix F 10.)

11. *Mispillion Creek, Delaware.*—The improvement of this stream has been in progress since 1879, with the design of dredging a 6-foot low-water channel 40 feet in width from the head of navigation to the entrance. The original depth over the shoals was about 4 feet at low-water. The first estimate of cost of dredging has been found to be too low, and in consequence revised estimates have been submitted based upon cost of previous work.

The officer in charge invites attention to the uncertainty that exists in this regard. For example, the dredging price in 1879 was 35 cents, increased during the last year under the $3,000 appropriation of June 14, 1880, to 45 cents. The difference in cost neutralized the whole appropriation and left the same amount, viz, $10,000, to be appropriated in order to complete the project.

The act of March 3, 1881, appropriated $3,500, which will be expended during the ensuing year, leaving a further sum of $6,500 needed to complete the 6-foot low-water navigation to the entrance.

The contract prices obtained by the usual methods, in pursuance of advertisements depend less upon the actual cost of any given work, than upon the engagements of the contractors and the presence or absence of competition. The cost of many of these smaller works is therefore frequently exceedingly disproportionate, and no estimate made in advance can be depended on. In addition to making appropriation for continuing the improvement, the act of March 3, 1881, directs an examination to be made of the entrance, where the main obstacle to free navigation exists. This examination will be made during the ensuing season.

July 1, 1880, amount available	$4,000 00	
Amount appropriated by act approved March 3, 1881	3,500 00	
		$7,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,000 00	
July 1, 1881, outstanding liabilities	48 28	
		4,048 28
July 1, 1881, amount available		3,451 72

Amount (estimated) required for the completion of existing project	$6,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	6,500 00

(Ses Appendix F 11.)

12. *Duck Creek, Delaware.*—The project for the improvement of Duck Creek entrance was to deepen the existing channel from 4 to 8 feet at low-water, with a least width of 100 feet, the length of the cuts being 600 yards.

The cost of the work proved to be considerably in excess of the estimate, and the amount of dredging practicable with the $5,000 appropriated in act of June 14, 1880, was correspondingly reduced.

At the close of work in November, the width was 50 feet for the greater portion of the distance, and 25 feet for the remainder.

A revised estimate was therefore submitted by the officer in charge in January, 1881, the amount required to complete the dredging of the entrance being $7,500.

With the $3,000, appropriated in act of March, 3, 1881, contract has been made for continuing the work.

It is probable, notwithstanding the stiff material through which the channel is made, that some protective works will be hereafter required to prevent the silting of the channel by the lighter materials set in motion by the tides and waves of the bay.

July 1, 1880, amount available..................................	$5,000 00	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$8,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880..............................	4,998 11	
July 1, 1881, outstanding liabilities............................	88 96	
		5,087 07
July 1, 1881, amount available		2,912 93
Amount (estimated) required for completion of existing project..........		16,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		4,500 00

(See Appendix F 12.)

13. *Cohansey Creek, New Jersey.*—The entrance to Cohansey Creek from Delaware Bay is over a wide mud shoal, with 5 or 6 feet at low-water. The character of the shoal and its extent are such that a dredged channel would not maintain itself, and permanent works of considerable cost would be required. Thence to Bridgeton, at the head of navigation, the stream, though tortuous, is of good natural capacity with a large rise of tide. The principal obstructions are at Bridgeton, and the appropriations hitherto made have been expended in that vicinity, with the view of obtaining a channel 7 feet deep at mean low-water, with an adequate width. During the past fiscal year a 7-foot low-water channel with an average width of 70 feet has been made to Broad Street Bridge, and thence to Commerce Street Bridge a narrow one of the same depth. Between this and the Nail Works Bridge a shoal was deepened to 4 feet at low-water.

At Broad Street Bridge the city gas and water pipes cross the stream at a depth of 4 and 5 feet only, below low-water. They therefore constitute an obstruction to the further prosecution of the improvement, which the city authorities have indicated their intention to remove by lowering the pipes. If the project hitherto authorized by Congress is to continue, these pipes must be sunk to such depth as will admit of free navigation over them, but notwithstanding the efforts of those interested in the navigation, the necessary action by the city has not been taken.

A re-examination of the lower part of the dredged channel will be made to ascertain whether further dredging will be required. To complete the project there is needed an appropriation of $10,000, but such completion will depend upon the sinking of the city pipes.

July 1, 1880, amount available	$4,701 17	
Amount appropriated by act approved March 3, 1881	7,000 00	
		$11,701 17
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		4,698 16
July 1, 1881, amount available		7,003 01
Amount (estimated) required for completion of existing project		10,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		10,000 00

(See Appendix F 13.)

14. *Salem River, New Jersey.*—Salem River formerly headed near Sharpstown, N. J., and discharged into Salem Cove in the Delaware. A bar in the cove obstructed the entrance to the stream, and its removal to 8 feet at low-water, with an average width of 100 feet, was completed during the past year with the $3,000 appropriated in act of June 14, 1880.

The act of March 3, 1881, appropriated a further sum of $3,000 for "improving Salem River, New Jersey."

It appeared that this appropriation was intended for the upper portion of Salem Creek, which by means of a dam had been separated from its lower portion and made to discharge through a canal debouching into the Delaware near Deep Water Point.

The appropriation will be expended in the partial removal of a shoal near Biddle's Landing, just above the junction of canal with creek.

The present depth is 3 to 5 feet at low-water, which will be deepened to 6 feet with a suitable width.

Two other small shoals will remain to be removed in order to carry the 6-foot low-water channel through to the head of navigation at Course's Landing, requiring an additional amount of $1,500.

July 1, 1880, amount available	$3,000 00	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$6,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,972 86
July 1, 1881, amount available		3,027 14
Amount (estimated) required for completion of existing project		1,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		1,500 00

(See Appendix F 14.)

15. *Chester Creek, Pennsylvania.*—In accordance with act of June 14, 1880, an examination of Chester Creek was made and estimates amounting to $10,781 submitted by the officer in charge for the removal of silt from the bed, so as to make a channel 7 feet deep at low-water at the entrance, diminishing upward.

The existence of several permanent bridges crossing the creek with space above high-water, limited to from 7 to 15 feet, will make the working of dredges impracticable above the lowest bridge, which is about 1,500 feet from the entrance.

The $3,000 appropriated in act of March 3, 1881, will be expended in dredging from the entrance to Third-street bridge, making a channel 7½ feet deep at mean low-water and 40 feet in width. The present channel depth is 4 to 5 feet only.

In view of the obstruction created by the bridges, the further prosecution of the work will depend upon whether a dredge can be found capable of passing under them.

Amount appropriated by act approved March 3, 1881	$3,000 00
July 1, 1881, outstanding liabilities	36 92
July 1, 1881, amount available	2,963 08

(See Appendix F 15.)

16. *Rancocas River, New Jersey.*—The act of June 14, 1880, directed an examination of the Rancocas River, which was made during the fiscal year, and a preliminary report and chart submitted by the officer in charge in January, 1881, with estimates of the cost of improvement.

The commerce of the stream called for an available low-water depth of at least 6 feet.

The entrance from the Delaware is naturally good, and the main obstructions were found at Coate's Bar, about 4 miles from the mouth.

The total estimate for the 6-foot navigation to Centreton, 7¼ miles from the mouth, was approximately computed at $42,000. Shortly above Centreton the river forks, and to carry a 5-foot navigation thence up the North Branch to Mount Holly, would cost $40,000 more.

The $10,000 appropriation in act of March 3, 1881, will be expended in improving the channel through Coate's Bar, over which the present depths are 4 and 5 feet only.

The continuation of the improvement will require an appropriation for the fiscal year 1882-'83 of $25,000.

Amount appropriated by act approved March 3, 1881		$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$131 00	
July 1, 1881, outstanding liabilities	49 04	
		180 04
July 1, 1881, amount available		9,819 96
Amount (estimated) required for completion of existing project		71,236 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		25,000 00

(See Appendix F 16.)

17. *Saint Jones River, Delaware.*—The estimates submitted by the officer in charge were based upon local representations by persons interested in the improvement.

According to his report the proper improvement of the entrance, to which he recommends attention should be first directed, will cost $35,000 for the attainment of a channel 3 feet deep at low-water; the construction of a jetty is necessary to secure useful results.

The appropriation of March 3, 1881, is $5,000. In view of the insufficiency of the amount, its expenditure has been suspended until it can be ascertained if Congress will sanction the plan of improvement for affording access to the stream from Delaware Bay.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	97 30
July 1, 1881, amount available	4,902 70
Amount (estimated) required for completion of existing project	30,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	30,000 00

(See Appendix F 17.)

18. *Susquehanna River, Pennsylvania, above Richard's Island.*—With the $15,000 appropriated in act of June 14, 1880, the improvement of

the river from Richard's Island, to Wilkesbarre, Pa., has been completed. The object in view has been the construction of a channel 3 feet deep at the low-water summer stage, and to effect this dredging has been required at several points within the limits mentioned.

Wilkesbarre Island divides the river into two channels, and for the purpose of directing the flow into the southern one a dike was built from the head of the island across the other to the main shore.

With the appropriation of March 3, 1881 ($15,000), contracts will be made to continue the improvement upward from Wilkesbarre towards Pittston, as far as the funds will admit the method of improvement, viz, dredging and the construction of cheap deflecting and intercepting dikes, and the proposed depth of channel, being the same.

The navigation of the Susquehanna is rendered difficult by reason of its gravel and rock bed and alluvial banks, combined with the large range of its volume, the depth varying at times from 2 feet in summer to 25 or more feet in flood.

July 1, 1880, amount available	$15,000 00	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$30,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	7,397 56	
July 1, 1881, outstanding liabilities	3,257 88	
		10,655 44
July 1, 1881, amount available		19,344 56
Amount (estimated) required for completion of existing project		33,537 50

(See Appendix F 18.)

19. *Iron Pier in Delaware Bay, near Lewes, Delaware.*—Operations under the appropriation of $10,000 in act of June 14, 1880, have been the placing of fender piles for the pier-head and the partial renewal of timber superstructure.

The construction of this pier has been in progress since 1872, with insufficient annual appropriations, and as it now draws near completion the decay of the exposed timber develops into a yearly-increasing item of cost. The amount needed at the present time to complete the pier is $13,000.

July 1, 1880, amount available	$10,005 54	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$20,005 54
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	10,583 84	
July 1, 1881, outstanding liabilities	494 54	
		11,078 38
July 1, 1881, amount available		8,927 16
Amount (estimated) required for completion of existing project		13,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		13,000 00

(See Appendix F 19.)

20. *Delaware Breakwater Harbor.*—The construction of the two works forming this harbor began in 1829, and was terminated in 1869. Since that date no expenditures upon it have been made beyond a special appropriation for the removal of several wrecks sunk in 1877.

Meanwhile the commerce to be protected has largely outgrown the capacity of the harbor, and in addition a steadily increasing deterioration in depth has taken place, which now threatens the destruction of the anchorage. Repeated reports have invited attention to these facts, the latest of which are printed in Annual Report, Chief of Engineers, 1879, pages 453 to 462, and recommendations have been urgently made and renewed, that in order both to increase the shelter and check the shoaling, the gap between the "Ice Breaker" and "Breakwater" should be closed.

The probable ultimate expense of this will be $500,000 or $600,000.

Attention is invited to the recommendation made in the last two annual reports for a preliminary appropriation of $150,000 for closing this "gap," which is renewed.

Amount that can be profitably expended in fiscal year ending June 30, 1883..	$150,000

(See Appendix F 20.)

21. *Removal of wrecks from Delaware Breakwater Harbor.*—The contract made in April, 1880, in pursuance of a special appropriation act approved January 23, 1880, for the removal of these wrecks, stipulated that the work should be completed by August following. This time expired before the complete removal of the first wreck attacked, and as the contractor was unwilling to guarantee the removal of more than three wrecks during the remainder of the year, the contract was annulled. After readvertisement a new contract was made August 31, 1880, but the loss of the most favorable part of the season, the early winter and prolonged inclemency of the spring greatly retarded operations.

The new contractors have an improved and efficient plant in operation, and the circumstances were held to justify an extension of their time. On July 1 three wrecks had been removed, and two others were nearly ready.

There is every reason to suppose that the harbor will have been cleared by October 1, 1881.

July 1, 1880, amount available		$23,773 22
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$1,806 20	
July 1, 1881, outstanding liabilities	17,446 50	
		19,252 70
July 1, 1881, amount available		4,520 52

(See Appendix F 21.)

22. *Port-Warden's Line, Philadelphia, Pennsylvania.*—The commission of United States officers advisory to the board of harbor commissioners of Philadelphia, has had under consideration during the past year, the subject of the proper determination of port-warden's lines for both the Delaware and Schuylkill rivers.

The commission reached the conclusion that an equal supervision of the lines for both banks of the Delaware was essential, and pending correspondence with the State authorities of New Jersey, took up the subject of the Schuylkill lines. In April, 1881, a report and chart were presented to the harbor commissioners, recommending lines on both banks, both for "wharf lines" and lines of solid filling. No notification of final action on the report had been received at the close of the fiscal year.

(See Appendix F 22.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with the provisions of the river and harbor act of June 14, 1880, Colonel Macomb was charged with, and has completed, the following:

1. *Rancocas River, from the Delaware River to Pemberton, Burlington County, New Jersey.* (See Appendix F 16.)
2. *Chester and Ridley Creeks, near their outlets in Delaware River.* (See Appendixes F 15 and F 24.)
3. *Appoquinimink Creek, Delaware.* (See Appendix F 23.)
4. *Saint Jones Creek, Kent County, Delaware.* (See Appendix F 17.)
5. *Little Creek, Kent County, Delaware.* (See Appendix F 25.)
6. *Christiana River, Delaware, with estimates of cost of procuring a mean depth of* 15 *feet from railroad bridge to the mouth of the river.* (See Appendix F 9.)

The results of the above were transmitted to Congress, and printed in House Ex. Doc. No. 34, Forty-sixth Congress, third session.

7. *Absecom Inlet, Atlantic County, New Jersey.* (See Appendix F 26.)
8. *Ice harbor at the head of Delaware Bay, near Morris Liston's, on Reedy Island.* (For preliminary report see Appendix F 27.)
9. *Survey of Delaware River.*—The chart of the Delaware from Liston's Point to League Island has been completed.

And to comply with provisions of the river and harbor act of March 3, 1881, he is charged with, and is now engaged upon the following, the results of which will be duly submitted when received:

1. *Frankford Creek, from its mouth in the Delaware River to Frankford avenue.*
2. *Five-mile Point, above Bridesburg, Delaware River.*
3. *Mouth of the Mispillion, Delaware.*
4. *Newton Creek, Camden County, from Delaware River to head of navigation.*
5. *Mantua Creek, Gloucester County, from Delaware River to head of navigation.*
6. *Maurice River, from Delaware Bay to Millville, Cumberland County.*
7. *Salem and Cohansey Creeks, New Jersey.*
8. *Murder Kiln, Delaware.*
9. *Delaware River.*
10. *The harbor of Delaware Breakwater and entrance thereto.*
11. *Indian River, in the state of Delaware, from its mouth to Millsborough.*

IMPROVEMENT OF HARBORS AND RIVERS ON EASTERN SHORE OF CHESAPEAKE BAY, AND OF THE SUSQUEHANNA, BUSH, AND PATAPSCO RIVERS, IN MARYLAND, ON THE WESTERN SHORE; OF BROAD CREEK, DELAWARE; OF JAMES AND APPOMATTOX RIVERS AND ONANCOCK HARBOR, VIRGINIA; OF GREAT KANAWHA, ELK, AND SHENANDOAH RIVERS, WEST VIRGINIA; OF NEW RIVER, VIRGINIA AND WEST VIRGINIA; AND OF CAPE FEAR RIVER, NORTH CAROLINA.

Officer in charge, Lieut. Col. William P. Craighill, Corps of Engineers, having under his immediate orders Capt. E. H. Ruffner, Corps of Engineers, since September 21, 1880; Capt. Thomas Turtle, Corps of Engineers, during the year, and Lieut. William M. Black, Corps of Engineers, until May 12, 1881.

1. *Susquehanna River, near Havre de Grace, Maryland.*—The first appropriation by the United States for this river was made in 1852, and an examination soon after showed that the navigation was obstructed by 2 shoals between the light-house at Havre de Grace and Spesutie Island, upon which there were respectively depths of 5 and 6 feet at mean low-water.

The originally adopted project for the improvement was to increase the depth by dredging to 12 feet at mean low-water. This has been done several times, but such an improvement not having been found to be permanent, it was proposed by the officer in charge in 1867 to contract the water-way by using a long jetty or deflector, commencing nearly opposite Havre de Grace. This idea was executed in 1868 and 1869 to as great an extent as the limited amount of funds available would allow, and the effect was found to be good. To make a permanent improvement of that kind will require the expenditure of $50,000, which should be all given in one sum.

The total amount expended on this portion of the river up to June 30, 1880, was $54,390. At that date very little had been done on the river for nearly ten years, and an examination showed the channel to be again obstructed by lumps, with not more than 8 or 9 feet on them at low-water. The channel was cleared again by dredging to a depth of 12 feet at mean low-water. The width was made not less than 90 feet, except where the depth before dredging was 11 and 11½ feet, and at such places the width of the dredging was only 45 feet.

Early in December, 1880, a number of the old "boom cribs" above the railroad bridge were removed by dynamite blasts, at an expense of less than $1,000. There has been also much work done at the light station called Donoho's Battery, for the purposes of the United States Commission of Fisheries, in the propagation of shad for distribution to various parts of the United States.

The amount expended in the year ending June 30, 1881, has been $35,878.31.

Some improvement of the channel between Havre de Grace and Port Deposit is desirable, and some further dredging may be needed below Havre de Grace. Before a reliable estimate of the cost of this proposed work can be made a partial resurvey is required. A special report will be submitted before the close of 1881. A severe ice-gorge occurred near Havre de Grace in February, 1881.

July 1, 1880, amount available	$28,000 00	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$43,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		35,878 31
July 1, 1881, amount available		7,121 69

(See Appendix G 1.)

2. *Northeast River, Maryland.*—The town of Northeast is situated on the river of that name, about 5 miles from its mouth. The river empties into Chesapeake Bay, nearly opposite the mouth of the Susquehanna, at Havre de Grace. The town is also on the Philadelphia, Wilmington and Baltimore Railroad, about midway between Philadelphia and Baltimore. The two streams, Great and Little Northeast, unite here to form the Northeast River.

The river at the town has a width of about 150 feet. The first survey by the Engineer Department was made in 1872, when there was found at the town a depth of 6 or 7 feet at mean low-water; but access by vessels of any size was prevented by shoals below, upon which the depth was only 2 feet or even less.

The project adopted for the improvement of this river was to dredge a channel, 60 feet wide at bottom with a ruling depth of 5 feet at mean low-water, from the 5-foot curve near the mouth of the river to Northeast, and making a turning basin in front of the wharf about 120 feet square. This work was done in the autumn of 1872 and the spring of 1873. The amount expended up to June 30, 1880, was $10,000.

By direction of Congress a re-examination of the river was made in October, 1879. The channel was found to have stood pretty well, although some deposition had taken place in it. It was redredged to a depth of 5½ to 6 feet at mean low-water, and the turning basin near town was made larger and deeper. The amount expended in the year ending June 30, 1881, was $5,499.62.

As well as can be ascertained, the work done up to this time seems to give satisfaction and to suffice for the commerce of which this small stream is the avenue.

No new appropriation is recommended.

July 1, 1880, amount available	$5,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	5,499 62
July 1, 1881, amount available	38

(See Appendix G 2.)

3. *Elk River, Maryland.*—The first appropriation by the United States for this river was in 1874, previous to which the channel in some places was not over 12 inches deep at low-water, with an average rise of tide of only about 2½ feet. In much of the river, however, the depth was great, in some places being not less than 24 feet. The width near the town of Elkton is 100 feet, and for 2½ miles below averaged about 200 feet. The width increases to ¾ of a mile at the mouth, which is 16 miles below Elkton.

The plan originally adopted for the improvement was the building of a dike 900 feet long, on the right bank of the stream, beginning about 1,100 feet below the bridge at the town; a channel was also dredged, 40 feet wide at bottom and 6 feet deep at low-water, from the town to a point about a ½ mile below; a basin was also excavated near the town to enable steamboats to turn in. The amount expended up to June 30, 1880, was $10,000, with the results stated above.

After 1875 no appropriation was made until June 14, 1880. An examination of the river immediately thereafter showed some shoaling in the basin and dredged channel. A contract was made for further work. In the year ending June 30, 1881, $4,814.49 had been expended, and with the following results: Beginning at a point 1 mile below the bridge, an excavation had been made up stream 60 feet wide and 7 feet deep at mean low-water for a distance of 1,660 feet, and a cut 40 feet wide and 8 feet deep carried still farther to a point 4,300 feet from the point of beginning.

After work under existing contracts is ended, which will exhaust appropriations now available, there will be required, in order to complete the existing project, viz, to dredge a channel 75 feet wide and 8 feet deep at mean low-water up to the town of Elkton, with a turning basin at the wharves, the removal of 35,000 cubic yards of material, the cost of which, at the last contract price, will be $12,000.

The dike below the town is also quite dilapidated, and will soon require extensive repairs or entire renewal at a cost of $1,500. An old crib or hulk near Frenchtown should be removed, at a probable cost of $100. Total to complete existing project, $13,600, which should be given in one appropriation.

No improvement of this kind is permanent. All such require repairs, like streets, roads, &c. It is supposed that $1,500 per annum would suffice for such repairs.

The trade on the river is yet small, but it is expected by the community interested to increase materially when the improvement is completed as projected.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$15,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,632 65	
July 1, 1881, outstanding liabilities	181 84	
		4,814 49
July 1, 1881, amount available		10,185 51
Amount (estimated) required for completion of existing project		13,600 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		13,600 00

(See Appendix G 3.)

4. *Chester River, Maryland, from Spry's Landing to Crumpton.*—This portion of Chester River is only 2 miles long. It is on the eastern shore of Maryland, nearly opposite the city of Baltimore. Seven feet of water can be carried at all stages of the tide to Spry's Landing, which is 7 miles above Chestertown, the most important town in that section. From Spry's Landing to Crumpton only 6½ feet can be carried at high-water. The range of the tide in that part of the river is about 2 feet. The bridge at Crumpton is somewhat of an obstruction to navigation, the width of the draw being but 37½ feet. Above Crumpton the channel is narrow and considerably more shallow than below.

A report to Congress relative to this river was made early in the session of 1880–'81. Estimates were presented for making a channel 8 feet deep at mean low-water, and with widths respectively of 100 and 120 feet, which amounted to $11,000 and $13,000. An appropriation of $6,500 was given March 3, 1881.

A contract has been made for its expenditure, the width of the channel being limited to about 80 feet. The width will be increased and the navigation to that extent improved if more money be granted by Congress.

Chester River separates the counties of Kent and Queen Anne, both of which are naturally rich and fruitful, producing large amounts of grain and fruit. The river is the natural route of these products to a market. Its improvement would doubtless increase the production of these crops and facilitate their movement.

Besides two regular lines of passenger and freight steamers between Baltimore and Crumpton, and several sailing vessels which carry freight, there are other steamers and sailing vessels making occasional trips in busy seasons.

Amount appropriated by act approved March 3, 1881	$6,500 00
July 1, 1881, amount available	6,500 00
Amount (estimated) required for completion of existing project	6,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	6,500 00

(See Appendix G 4.)

5. *Chester River at Kent Island Narrows, Maryland.*—Nothing has been done at this locality since September, 1877. Kent Island Narrows formerly, as it does now, connected Eastern Bay with Chester River, and separated Kent Island from the mainland. Some sixty years ago a close causeway was constructed at the narrowest part, under the authority of the State of Maryland, thus connecting the island with the mainland and interrupting navigation through the narrows. It is re-

ported that vessels drawing 7 or 8 feet passed through this water-way before the construction of the causeway.

The first appropriation for the restoration of this navigation by the United States was made in March, 1873, $15,000, and the project was to make a channel 7 feet deep at mean low-water, 100 feet wide.

The Secretary of War decided not to proceed with the work until the law authorizing the maintenance of the causeway should be repealed and a bridge be substituted therefor with a draw not less than 60 feet in width. These conditions were, after much delay, complied with, and the work of the United States was begun May, 1875. The project was finally completed essentially, but the width of the cut was made only about 80 feet on the Eastern Bay side, and of the same width for a small part of the Chester River side. The disturbance of the routine to which the tidal currents had been so long accustomed by this opening of the causeway caused some scour and some deposition where they had not been entirely expected, but the project was successfully carried out.

The passage is now used, to a considerable extent, by sailing vessels. It is, however, rarely used by steamers, though it is believed to be of ample dimensions for the accommodation of the class for which it was designed.

The total of the appropriations for this work is $28,000, of which a balance of $2,581.45 remains in hand. A resurvey was made in the spring of 1880. There is no need existing at present for pending the available balance.

July 1, 1880, amount available	$2,581 45
July 1, 1881, amount available	2,581 45

(See Appendix G 5.)

6. *Harbor of Queenstown, Maryland.*—This harbor is on the eastern shore of Maryland, nearly opposite the city of Baltimore, looking down the Patapsco River. Though small, originally it was quite commodious and had an average depth at mean low-water of 9½ feet. The channel connecting the harbor with Chester River was narrow, crooked, and with no greater average depth than 6 feet.

The original project of improvement, adopted in 1871, was to widen the channel to 100 feet, to decrease the curvature of bends, and to deepen it to 8 feet at mean low-water, nothing being deemed necessary in the harbor proper. This was accomplished in December, 1872, with an expenditure of $11,000. In March, 1879, an additional appropriation of $3,000 was made, which was expended partly in redredging the channel to 8 feet at mean low-water at a few points where some deposition had taken place, but chiefly in still further reduction of curves. This work was completed August 16, 1880. The material dredged was partly hard sand and partly a tough, light-colored clay.

The total amount expended on this harbor to June 30, 1880, was $11,101.44.

The amount expended in the year ending June 30, 1881, was $2,898.56.

The harbor and channel are now in good condition according to the plan indicated above. No appropriation is needed for the fiscal year ending June 30, 1883.

July 1, 1880, amount available	$2,898 56
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,898 56

(See Appendix G 6.)

7. *Patapsco River, Baltimore, Maryland.*—By nature the channel of approach to Baltimore had in it some places with not more than 16 or 17 feet at mean low-water. This depth was increased at high-water by 18 inches. The commerce of Baltimore was therefore of necessity carried on in vessels of rather small size.

The project of improvement at first adopted, and commenced in October, 1853, had for its object to give a channel 22 feet deep at mean low-water, with a width of 150 feet. Little was done before the late war, but afterwards these dimensions were increased, a depth of 24 feet at mean low-water being determined upon, with a width of channel ranging from 250 to 400 feet. This channel was completed in 1874, important changes of position having been given to a portion of it, by which the distance was materially lessened and the expense of maintenance decreased. The object of this improvement was to permit the approach to Baltimore at mean low-water of vessels drawing from 22½ to 23 feet, and at ordinary high-water of vessels drawing 24 or 24½ feet.

Up to June 30, 1880, the United States had expended $1,042,854.59, with the results indicated above. The city of Baltimore and the State of Maryland, chiefly the former, had contributed to the same object $534,000.

All that has been done in the year ending June 30, 1881, has been the widening of the upper end of the channel, near Fort McHenry, which was commenced May 1, 1880, was in progress at the date of the last annual report, and was completed in October, 1880. The contractors removed 181,930 cubic yards of material at a cost of 18.7 cents per cubic yard.

Upon a call from Congress for information as to the cost of increasing the depth of the channel to 27 feet at mean low-water, a report was made in January, 1881. The estimated cost amounted to $1,250,000. Congress sanctioned this step forward in the improvement in express terms in the river and harbor act of March 3, 1881, and appropriated $150,000 for commencing it. While this increase of depth is being had, an important change will be made in the position of a part of the channel, by which the distance will be again lessened and the cost of maintenance decreased.

To complete this improvement in the shortest possible time would be true economy. All the advantages of the improvement can only be had when it is completed.

The longer the time given to the work, the longer will Baltimore be kept waiting for what her commerce seems to need at once.

The longer the time given to the work, the longer will the existing commerce be vexed by the presence of many dredges working in the channel, for while these machines are deepening the channel, they must be in it and more or less in the way of passing vessels.

The work is under contract as far as the funds available will allow.

The increase in the importance of Baltimore as a place of export and import is a matter generally known. For full particulars as to these points, reference is requested to the statement made in a communication from Hon. J. L. Thomas, collector, appended to the report of the officer in charge of the improvement.

The following facts are, however, given, taken from the last published annual report of the Chief of the Bureau of Statistics:

In the value of the imports and exports of merchandise into and from the United States during the year ending June 30, 1880, Baltimore had the fourth rank.

In the amount of duties collected on imported merchandise during the same year, Baltimore was fifth.

In amount of tonnage entered during the same year, Baltimore was second only to New York.

In the number of immigrants received during the same year, Baltimore was fifth.

In the amount of tonnage cleared in the same year, Baltimore was second only to New York.

July 1, 1880, amount available	$218,975 41	
Amount appropriated by act approved March 3, 1881	150,000 00	
		$368,975 41
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		46,258 31
July 1, 1880, amount available		322,717 10
Amount (estimated) required for completion of existing project		900,000 00
Amount that can be profitably expended in fiscal year ending June, 30, 1883		900,000 00

(See Appendix G 7.)

8. *Harbor of Annapolis, Maryland.*—There are two bars with not more than 18½ feet on them at mean low-water, which prevent very large ships from passing into the deeper water (24 feet and more) of the Severn River, just abreast of the Naval Academy. The commerce of Annapolis is small. Its importance arises mainly from its being the seat of the Naval Academy, and from its strategic relations to the capital of the nation.

The project adopted for the improvement of the harbor and the entrance to it has been the creation, by dredging, of a chanel 24 feet deep at mean low-water, with a minimum width of 150 feet. The rise of the tide is only about 1 foot.

The cost of this improvement has been estimated to be $66,000.

Two appropriations have been made, one of $5,000, June 14, 1880, the other, also of $5,000, March 3, 1881. As the expenditure of $10,000 would not effect any substantial improvement, it has been decided to await further action of Congress in this case.

If any additional appropriation be made, it should be for the balance required to complete the estimate for the channel 150 feet wide, 24 feet deep, $56,000.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880,		794 02
July 1, 1881, amount available		9,205 98
Amount (estimated) required for completion of existing project		56,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		56,000 00

(See Appendix G 8.)

9. *Choptank River, between Denton and Greensborough, Maryland.*—This portion of the Choptank River is about 8 miles in length, in Caroline County, on the eastern shore of Maryland, opposite Annapolis, on the western shore, and midway between Chesapeake and Delaware bays. About 9 or 10 feet of water (except at one point) can be found at mean low-water as high as Denton, where the mean rise of tide is about 2 feet. The width at Denton is 200 feet, at Greensborough 160 feet, but is very variable between those two points, being in one place 650 feet.

The depth is also very variable. There are stretches with 8, 7, or 6 feet at low-water, but there are numerous and extensive shoals with but 4, 3, or even 2 feet at mean low-water. There is a bridge at Denton, and one 3½ or 4 miles below. These have draws in them about 50 feet wide.

The estimate submitted to Congress at the session of 1879-'80 was for an 8-feet low-water channel, 75 feet wide, $79,000. It was stated, however, that the cost would be much reduced if the depth was kept at 7 feet.

Congress appropriated $5,000 June 14, 1880. A re-examination of the river showed that a 6-feet low-water channel, 75 feet wide, from Passapee's Landing to Case's Wharf, near Greensborough, could be made for $40,000. It was concluded to begin the dredging of such a channel. Proposals were called for by advertisement and a contract entered into for the work. Another appropriation of $5,000 was made, March 3, 1881, which is also under contract. It is expected that both will be exhausted in 1881 in dredging about 1⅜ miles in length of the proposed channel, beginning at a point about 400 feet above Cary's Wharf. Nothing was expended up to June 30, 1880. The amount expended up to June 30, 1881, was $331.69.

If Congress should make another appropriation, it will be expended in continuing the work already begun, as explained above. True economy in works of this class would induce the appropriation at once of the whole sum needed, if no other interests had to be considered.

Denton has about 500 or 600 inhabitants. Greensborough is a little larger. Both are thriving towns. The articles of shipment by the river are chiefly grain, lumber, and fruit, which occupy two lines of steamers to Baltimore from Denton and some small sailing vessels. It is expected that the improvement of the river to Greensborough would greatly increase the trade.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		331 69
July 1, 1881, amount available		9,668 31
Amount (estimated) required for completion of existing project		30,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		10,000 00

(See Appendix G 9.)

10. *Secretary Creek, Maryland.*—Secretary Creek is a short stream, tributary to the Choptank River, which it enters about 21 miles from its mouth. The whole length is not much over 3 miles. It is the water outlet for the trade of the town of East New Market and a surrounding country, fertile and thickly settled, of about 80 square miles. Before 1877 not more than 4 or 5 feet of water, perhaps not so much, could be carried up to the town wharf. In that year a fund was raised by subscription, and between $4,000 and $5,000 were spent in dredging to a depth of 7 or 8 feet at low-water. Not as much dredging could be done as seemed required by the trade on the creeks, and the channel was left still quite crooked and difficult of navigation.

Under the order of Congress, a survey of this creek was made in September, 1879, and estimates presented for channels of 7 and 8 feet depth at mean low-water, and of widths, respectively, of 75 and 100 feet.

The first appropriation was of $3,000, June 14, 1880, of which nothing was expended up to June 30, 1880. A second appropriation of $3,000 was made March 3, 1881. The result of the expenditure of these two appropriations, which was completed in May, 1881, was the excavation of a channel 7 feet deep at mean low-water and not less than 100 feet wide at any point. The curvature of the bends was also made much less, and the navigation of the stream much facilitated. A turning-basin was also dredged near the upper wharf. The amount expended during the year ending June 30, 1881, has been $5,806.24.

There is a daily line of steamers connecting this locality with Baltimore. There are also several small sailing-vessels trading to Baltimore and elsewhere. Besides the regular steamers, others enter the creek occasionally. The shipments of grain are considerable, as well as the return freights from Baltimore.

During the fruit season the business is very heavy.

July 1, 1880, amount available	$3,000 00	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$6,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		5,806 24
July 1, 1881, amount available		193 76

(See Appendix G 10.)

11. *Harbor of Cambridge, Maryland.*—The town of Cambridge, the county seat of Dorchester County, is situated about 18 miles from the mouth of the Choptank River, on the eastern shore of the Chesapeake, about 70 miles from the city of Baltimore. Communication with Baltimore is maintained by two lines of steamboats. The town is also the terminus of the Dorchester and Delaware Railroad, which connects it with the railroad system of Delaware and brings it into direct and speedy communication by rail with the principal cities of the Middle Atlantic region.

The original survey by the Engineer Department was made in October, 1870, which showed the harbor and the entrance to it from the Choptank River to be very shoal. The citizens of the place had previously endeavored to improve the harbor themselves, but they had not money enough, and what they did amounted to little in the way of permanent improvement.

The plan of improvement carried out by the Engineer Department has been to make a channel from the deep water of the Choptank to the railroad wharf in the inner harbor, and to increase the dimensions of that harbor, the outer channel to be not less than 100 feet wide, and the depth of all the dredging to be 8 feet at mean low-water. The plan was completed in March, 1879. The amount expended up to June 30, 1880, was $29,801.90.

The last resurvey of the harbor and its approaches was made in March, 1880, when their condition was found to be good. The balance of former appropriations, $2,698.10, is held in reserve for expenditure when a necessity therefor may arise.

The Choptank is a fine river; 20 feet water can easily be carried for some distance above Cambridge. The town has considerable advantages for ship-building, and has engaged to some extent in that business.

The western terminus of a favorable route for the proposed ship-canal between Chesapeake and Delaware bays is on Ferry Creek, a tributary of the Choptank, very near Cambridge.

Some of the leading citizens of the town are desirous to have more enlargement of the harbor and its approaches. The necessity of this can only be judged of when a resurvey is made, which is expected to be undertaken before the meeting of Congress. The results will be communicated in a special report if required.

July 1, 1880, amount available	$2,698 10
July 1, 1881, amount available	2,698 10

(See Appendix G 11.)

12. *Treadhaven Creek, Maryland.*—This stream is one of the tributaries of the Choptank River. Up to Easton Point, the head of navigation, the least depth was by nature about 7 feet at mean low-water in the channel. This was for a short space near Easton Point. Generally there was a depth of 8 to 8½ feet at mean low-water, but the channel was quite intricate and narrow in some places.

In the first report on this creek estimates were submitted for channels of 7 and 8 feet in depth at mean low-water, and of the widths of 100, 150, and 200 feet from the 8-feet water near the mouth to Easton Point. The first appropriation was made June 14, 1880, $3,000, and a second of the same amount. With them a channel has been dredged, nowhere less than 150 feet in width, and of a depth of 8 feet at mean low-water, up to the wharves at Easton Point, which is the landing for the town of Easton and really a part of it.

July 1, 1880, amount available	$3,000 00	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$6,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		3,016 34
July 1, 1881, amount available		2,983 66

(See Appendix G 12.)

13. *Water passage between Deal's Island and Little Deal's Island, Maryland.*—These islands are on the eastern side of Chesapeake Bay, quite near the mainland, just off the mouth of Manokin River, and opposite the inside entrance of Holland's Straits. They are nearly opposite, but a little above, the mouth of the Potomac River.

The "water passage" between the two islands is usually called the Lower Thoroughfare, to distinguish it from the upper passage, which separates the upper island from the mainland. Many persons consider the upper passage more important and worthy of improvement than the lower. Congress directed a survey of the lower passage in June, 1880, which was made in October, 1880.

A survey of the upper passage was directed March 3, 1881, and will be made before the meeting of Congress in regular session.

The passage at its western end is about 3,000 feet wide. At the narrowest point it is about 600 feet wide. The channel itself is much narrower. The depth at one part of it is for some distance not greater than 2½ feet. The thoroughfare is only navigable for small vessels, which can pass through it upon the higher stages of the tide.

It was estimated that to dredge a channel 100 feet wide and 7 feet deep, at mean low-water, from Tangier Sound along by the wharves of Daniel and of Vetra & Son (the only wharves thereabout), with a turning-basin at the upper end, would cost about $10,000; and to give the channel such protection as to make it probably permament would cost $20,000 more.

The first appropriation was made March 3, 1881, $5,000. A contract has been entered into for dredging a channel with a depth of 6 feet at mean low-water from the mouth of the thoroughfare, a distance of about one-half a mile, to a point opposite Daniel's Wharf, with a turning-basin at the upper end 200 feet square.

To complete the dredging as projected will require an additional appropriation of $5,000. The fact should not be overlooked, however, that to give permanence to the improvement will necessitate the immediate expenditure of $20,000 more.

The principal occupation of the people interested in this improvement is taking oysters, which is carried on by quite a number of schooners, sloops, and canoes. Along the west coast of these islands no harbors exist other than the two thoroughfares mentioned, and these are available only for smaller craft. Larger vessels, such as schooners and sloops, having no protection from westward storms, are frequently beached and sometimes wrecked by sudden gales.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount available	5,000 00
Amount (estimated) required for completion of existing project	5,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	5,000 00

(See Appendix G 13.)

14. *Broad Creek, Delaware, from its mouth to Laurel.*—The head waters of this creek are near the Cypress Swamp in Southern Delaware. It has a westerly course from Laurel, emptying into the Nanticoke about 5 miles above the forks and about 6 miles below Seaford, Del. The The distance from Laurel, the head of tide-water, to the mouth of the creek, is about 7 miles.

From the mouth of the creek to Portsville, a landing about 4 miles below Laurel, there are not less than 10 feet at mean low-water, and the rise of the tide is about 3 feet. This depth is somewhat more than can be carried up the Nanticoke to the mouth of the creek. There is one point on the Nanticoke below where there are but 8½ or 9 feet at low-water. There is but one other landing of any importance on the creek, Louisville, which is about a mile above Portsville. Louisville is the present head of navigation for vessels of any size; it is a small town of about 300 inhabitants; its principal business is repairing and fitting out vessels owned on and trading from the creek. Portsville is a small village with less than 100 inhabitants.

Broad Creek is crossed at Laurel by the railroad bridge, an ordinary trestle bridge without a draw, but with a span of 35 feet for the passage of lighters and small boats, having a clear height of 18 feet above the water. The county bridge, 1,600 feet above the railroad, is also a trestle bridge without a draw. There are no other bridges on the stream below Laurel.

From Portsville to about 1 mile above Louisville there is an available depth of 7 feet at mean low-water, the channel in some places being not over 50 feet wide. In this portion the width of the creek varies from 150 to 275 feet, but there are several sharp changes of direction which are unfavorable for free navigation. The remainder of the creek, so far up as Laurel, is very shoal, the depth decreasing rapidly to 3, 2, 1, and ½ feet and even less.

It was estimated by the officer in charge of the work $46,500 would be required for dredging alone, to make a channel 7 feet deep at mean low-water and 60 feet wide, and this should be increased to $60,000, if contraction of the water-way were attempted by wing-dams and training-walls. The sum of $5,000 having been appropriated June 14, 1880, it was decided to excavate a channel 20 feet wide 4 feet deep at mean low-water, extending from the railroad bridge at Laurel to a point below Big Mills, a distance of 5,373 feet, following the south side of the proposed deeper channel. The work was advertised, but the bids received were too high and were rejected. The work was again advertised, with the same result.

A new appropriation of $10,000 was granted March 3, 1881. More money being thus available, it was decided to attempt to excavate a channel 32 feet wide, 6 feet deep at mean low-water, from the bridge at Laurel, following the south side of the proposed channel for 6,500 feet. This work has been placed under contract and will be prosecuted as rapidly as possible.

It is estimated that $10,000 can be expended in the fiscal year ending June 30, 1883, with as much benefit and advantage as from the appropriations already made by Congress for this creek. Its commercial condition and prospects appear from the printed statements in the Annual Report of 1880, pages 640, 641, 642, and 643.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$15,000 00
July 1, 1881, amount expended during fiscal year exclusive of outstanding liabilities July 1, 1880		89 58
July 1, 1881, amount available		14,910 42
Amount (estimated) required for completion of existing project		45,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		10,000 00

(See Appendix G 14.)

15. *Wicomico River, Maryland.*—The natural channel of this river, for some distance below the town of Salisbury, was quite crooked and narrow, and at the shoalest places did not afford more than a few inches of water at low-tide. Much injury had also been done by the saw-mills pouring their dust into it. A considerable portion of the shoals was found to be composed of water-soaked sawdust mixed with mud and sand. It should be stated here that this supply of sawdust to the river has for several years been entirely cut off.

The project for improving this river was adopted in 1871, and had in view giving a depth of 7 feet at mean low-water in a channel about 70 feet wide for a distance of about 2 miles below the bridge at Salisbury. The project also included some dikes for the contraction of the water-way and as a place behind which to deposit material dredged from the channel.

Up to June 30, 1880, the amount expended had been $33,000, and at that date a channel 65 feet wide and 7 feet deep at low-water had been carried to a point 1,850 feet from the bridge. A channel of less width and depth had been carried to the bridge, a draw had been put in the bridge by the community, and some dredging had been done above the bridge by property owners.

The amount expended in the year ending June 30, 1881, is $4,965.21. The channel, 65 feet in width, has now been finished to the bridge, and a good turning-basin has been excavated in both forks near the town. A new steamboat line has commenced operations, connecting the river in this way with Baltimore; an advantage not possessed by that community before.

July 1, 1880, amount available	$5,002 33	
Amount appropriated by act approved March 3, 1881	2,000 00	
		$7,002 33
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		4,965 21
July 1, 1881, amount available		2,037 12

(See Appendix G 15.)

16. *Pokomoke River*, *Maryland*.—This is a river of the eastern shore of Maryland, its mouth being nearly opposite the mouth of the Potomac River, on the western shore of Chesapeake Bay. The portion of the river needing improvement was the stretch about 6 miles below Snow Hill, in Worcester County. The natural channel was originally about 7 feet in depth at mean low-water, which was increased at high-water 2¼ feet by the rise of the tide, but the channel was in some places very narrow, and in others very crooked, in some both narrow and crooked, besides being obstructed by a number of cypress stumps.

The project of improvement adopted consisted chiefly in the rectification of the channel by the trimming off of sharp angles, in giving increased width, and the removal of stumps where in the way. A special feature was the cut-off through the point opposite Dighton, by which two or three very sharp bends were gotten rid of. The depth of the channel was kept at 7 feet at mean low-water, with an average width of about 100 feet.

The total amount expended up to June 30, 1880, in completing the plan as outlined above was $12,365.71. The amount expended in the year ending June 30, 1881, has been $134.29. The work stands well and no appropriation is required for the year ending June 30, 1883.

July 1, 1880, amount available	$134 29
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	134 29

(See Appendix G 16.)

17. *Onancock Harbor*, *Virginia*.—The town of Onancock, at the head of the creek of the same name, is in Accomac County, on the eastern shore of Virginia, nearly opposite the mouths of the Potomac and Rappahannock rivers. Before the improvement by the United States, there were only about 4½ feet on the bar at low-water, and about 6 feet on the shoalest part of the approaches to the town. The channel was also quite crooked.

The project of improvement estimated for was to dredge a channel across the bar, 8 feet deep at mean low-water and 300 feet wide, and to make the channel to the town of the same depth and 100 feet wide. This could not be entirely carried out for want of funds.

The amount expended up to June 30, 1880, was $1,050.86. At that date the channel across the bar had been made 100 feet wide, and nothing had been done to the stream proper.

The amount expended in the year ending June 30, 1881, was $6,425.70. A channel was carried to the wharves of the town not less than 100 feet wide and 7 feet deep at mean low-water, and a turning-basin was made at the town of the same depth.

July 1, 1880, amount available	$6,869 93
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	6,425 70
July 1, 1881, amount available	444 23

(See Appendix G 17.)

18. *James River*, *Virginia*.—Previous to 1870 the first 4 miles below Richmond were shallow except in short reaches, the general depth being 8½ feet in channel at low tide. The reef at Rocketts and the sand shoal known as Richmond Bar had but 7 feet. Warwick Bar, 5 miles below the city, had 13 feet. The channel below Richmond was tortuous and obstructed with a large number of rocks, mostly bowlders, besides the ledges at Rocketts and Goode's. Many vessels, sunk during the war of 1861–'65, especially at Drewry's Bluff, were very serious obstructions. The Dutch Gap Cut-off, which now saves 5½ miles of difficult

navigation, was not open. After the flood of 1870 but little over 6½ feet could be carried over Richmond Bar at low-tide.

The original project for improvement was for 18 feet at high tide, with a channel width of 180 feet from the Richmond Dock to below Harrison's Bar. The mean rise and fall of tide is about 3½ feet, and the excavations in rock were to be carried to 15 feet at low-water. In removing sand shoals, where the operation is aided by wing-dams, the intention has been to so contract that the scour would produce a channel of the same depth. The only intentional change in plan has been to make the channel below Warwick Bar, 5 miles below Richmond, 200 feet by 18 at low-tide instead of high-tide.

The amount expended by the United States to June 30, 1880, was $441,542.46, and by the city of Richmond $356,710. At that date there was a depth of 17 feet at high-water up to Warwick Bar, and of 16 feet from Warwick to the wharves at Rocketts.

The amount expended in the year ending June 30, 1881, by the United States has been $56,989.47, and by the city of Richmond $26,301. The results of the year's work are a depth in channel of 20 feet at high tide from the sea to City Point, of 19 feet thence to Warwick Bar, and of 17 feet thence to the wharves at Rocketts. There has been also an improvement in the width and direction of channel at several places, but the channel is still too narrow in others, as for instance at Rocketts.

The amount needed to complete the original scheme, $130,000, could be profitably expended in the year ending June 30, 1883. What is appropriated should be applied to widening and deepening the channel in the hard material near Richmond; in completing the system of contraction, as now designed; and in continuing the improvement of the channel between Varina and City Point, and between Warwick and Dutch Gap.

The permanence of the improvement through shoals of alluvium can only be maintained by permanently contracting the river at these points. The contraction has heretofore been made for the most part with timber structures, which are not permanent. These structures are being revetted with material dredged from the river, much of which is suitable for that purpose and permanent, but a larger amount than is likely to come from the river under the present scheme will be required to permanently protect the wing-dams already built. The increase in the estimate for permanent improvement on the present plan is $85,000.

It should be observed that Congress has directed an examination of the river to be made, with a view to ascertaining the practicability and cost of deepening the channel to 25 feet at high-water. If a further deepening is undertaken, the lines of contraction should be brought nearer together, and the permanent work on any training-walls parallel to the current built under the present plan would be in great measure lost. It is also likely that the repairs to timber dikes from time to time may be less than the interest on the cost of permanent work.

July 1, 1880, amount available	$88,457 54	
Amount appropriated by act approved March 3, 1881	60,000 00	
		$148,457 54
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	56,269 92	
July 1, 1881, outstanding liabilities	719 55	
		56,989 47
July 1, 1881, amount available		91,468 07
Amount (estimated) required for completion of existing project		130,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		130,000 00

(See Appendix G 18.)

19. *Appomattox River, Virginia.*—Mr. H. D. Bird, long the local assistant engineer for the improvement, stated in one of his reports that at the close of the war there was on this river "only a 6½-feet navigation," meaning thereby 3½ feet at low-water, and 6½ at high. The scheme of improvement has been to give a depth of 9 feet at low-water, with as great a width as the river would bear with that depth. This was adopted in 1870.

The channel from Petersburg to the deep water below is naturally divided into three parts. In that division called the South Channel, which is a natural channel, nothing has as yet been done but to dredge.

A channel was cut previous to 1873, with a width of 60 feet at bottom; this has continued to stand remarkably well, though there is some deposition in it. The next division above the South Channel, called the Puddledock Channel, is altogether an artificial cut through a swamp. In 1876 this cut had been made 100 feet wide, with embankments on the sides planted with willows. At the head of this cut the river was turned entirely from the original channel, and passed through the new cut. The division above to the city of Petersburg is called the Petersburg Channel, and has been improved by the use of wing-dams and training-walls, the channel to be about 100 feet in width. The system is yet incomplete.

The amount expended on the Appomattox up to June 30, 1880, was $282,305.26, with the results stated above. Eight and one-half feet at low-water, or 11½ feet at high-water, can be now taken to the wharves of the town. The depth may be easily maintained when the remainder of the works projected are completed.

The amount expended during the year ending June 30, 1881, has been $19,893.14. The system of wing-dams and training-walls is not yet completed for want of money, but it has acted well; and with some assistance from the dredge-boat, the river has generally been in better navigable condition than it was ever known to be before. With sufficient appropriations to finish the system and make it permanent, there is little doubt of complete success.

The last appropriation was made applicable to the harbor at Petersburg, and it becomes a difficult question to decide what the United States should do in that harbor (which is very contracted, but still apparently large enough for the existing requirements of its commerce), unless the money of the General Government be expended in dredging at the wharves of private parties or corporations. A scheme of partial diversion of the river into another channel has been urged by some, originating with the late Mr. Bird. It is worthy of examination, but some surveys are needed to decide as to its practicability and propriety. A survey of the harbor of Petersburg has also become necessary, in view of the phraseology of the last appropriation. When these surveys are completed, and a revised estimate made, a special report will be submitted.

July 1, 1880, amount available	$20,194 74	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$40,194 74
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		19,893 14
July 1, 1881, amount available		20,301 60

(See Appendix G 19.)

20. *Shenandoah River, West Virginia.*—This river, rising not far from Staunton, in Virginia, passes through a beautiful and fertile valley and

empties into the Potomac at Harper's Ferry. It flows alternately through pools of comparatively slack water, and over ledges and shoals, forming rapids and falls. As is usual with such streams, the pools are shorter and the ledges more numerous on the upper reaches than the lower; on the upper 40 miles the pools rarely, if ever, exceed a mile in length, with from 2 to 4 feet depth of water, while on the remainder of the stream (to the head of Little's Falls) they frequently attain a length of 3 or 4 miles, with depths of 4 to 7 feet of water. The river below Little's Falls is almost a continuous succession of ledges.

For many years before the late war a system of down-stream navigation for flat-boats was maintained, the work above Little's Falls consisting of low wing-dams and sluices, and below that point of a system of locks and canal combined with sluices and open river navigation. All traces of the works above Little's Falls have disappeared, and those below are in a very dilapidated condition since the freshets of 1870 and 1877. What has been generally desired by the people interested has been the restoration of the navigation as it existed before the war.

Two appropriations have been made for the part of the river in West Virginia, one of $15,000, June 14, 1880, and one of $2,500, March 3, 1881. The last had a proviso that neither should be expended "until any corporate rights or franchises that may exist on said river shall have been relinquished to the United States to the satisfaction of the Secretary of War." This relinquishment has not been made.

July 1, 1880, amount available	$15,000 00	
Amount appropriated by act approved March 3, 1881	2,500 00	
		$17,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		187 80
July 1, 1881, amount available		17,312 20
Amount (estimated) required for completion of existing project		7,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		7,500 00

(See Appendix G 20.)

21. *New River, from the mouth of Wilson, in Grayson County, Virginia, to mouth of Greenbrier River, in West Virginia.*—From the mouth of Wilson, in Grayson County, Virginia, to steamboat landing at Hinton, Summers County, West Virginia, 1½ miles below the mouth of Greenbrier River, is 191½ miles. The appropriations have been made in such a manner as to divide this portion of the river into three sections as follows:

	Miles.
Upper or Lead Mines	62
Middle or New River Bridge	43
Lower or Greenbrier	86½

Throughout this distance, the navigable channel originally consisted of natural chutes, through the ledges and shoals, of varying widths, rarely over 1 foot in depth, in some places so tortuous as to render navigation extremely difficult and dangerous.

The original project adopted for the improvement of these natural channels was to widen them to 30 or 50 feet, as might be required, and deepen them to 2 feet, and straighten such as needed it. This was for keel-boat navigation, the improvement, however, to be made in such a manner as to aid the work, should a greater depth and width be required in the future.

A small steamboat, draught 12 inches, when light, having been built at Hinton, in the fall of 1878, rendered it necessary to make the channel, in that section, 50 feet wide at all points, and in many from 75 feet to 100 feet, the depth of 2 feet being retained.

June 30, 1880, there was a channel, 50 feet wide and 2 feet deep, from Hinton Landing to Hubbard's Ripple, a distance by river of 12¼ miles, giving an outlet to the products of Mercer County, West Virginia.

At the close of the season's work for 1880, there was a channel, of the same width and depth, from Hinton Landing to McDaniel's or Harvey's Falls, a distance of 17¾ miles, giving an outlet to the farmers and graziers of Crump's Bottom and the Indian Creek country. And, in addition to the above, 12 miles of improvement from New River Bridge to Peak's Creek, with a channel 30 feet wide and 2 feet deep, giving outlet for timber and farm products, but not available for iron or other ores, until Radford Furnace can be reached.

The appropriation for the fiscal year ending June 30, 1882, will carry the improvement on the Greenbrier division through Wiley's Falls, 26 miles above Hinton, passing the mouth of Lick Creek, 20 miles above Hinton, thus opening up the trade from Tazewell and other rich counties adjoining.

The appropriation for the fiscal year ending June 30, 1882, will carry the improvement on the New River Bridge division to Carter's Ferry, 33 miles above the bridge, and give an outlet to the iron from Radford Furnace, 18 miles above the bridge, to the ores from an iron mine 8 miles beyond, to Graham's new furnace and iron-works, the former 31 miles, and latter 33 miles above the bridge, as well as to two zinc mines in the same section.

The appropriation for the fiscal year ending June 30, 1881, will carry the improvement on the Lead Mines division to the "Gulf," 8 miles above the mines, giving outlet to charcoal and timber.

No appropriation for the fiscal year ending June 30, 1882.

With a channel, as now proposed, 20 feet wide and 2 feet deep, the estimate of $181,000 would be sufficient to complete it, but as that portion from Hinton to New River Bridge has to be made 50 feet wide, at a cost of about $2,000 per mile, the above amount should be increased to $275,000, and if it becomes absolutely necessary to use locks and dams for the improvement of some of the falls, this estimate will have to be further increased by the amount of their cost.

On the lower division there are 8 keel-boats, 6 tons each, 18 inches draught, loaded; one small stern-wheel steamboat, 30 tons, 18 inches draught, loaded, and another being built.

On the middle division two keel-boats, of the same tonnage and draught as above, are in use carrying ores, and six more building.

On the upper division only canoes are in use. Many rafts on each of these divisions, but their number was not ascertained.

July 1, 1880, amount available	$24,083 26	
Amount appropriated by act approved March 3, 1881	24,000 00	
		$48,083 26
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		16,179 09
July 1, 1881, amount available		31,904 17
Amount (estimated) required for completion of existing project		181,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		25,000 00

(See Appendix G 21.)

22. *Great Kanawha River, West Virginia.*—This river flows through a fertile and picturesque region, filled also with mineral wealth, espe-

cially coal and salt. It was by nature divided into a number of pools, some of considerable length and depth, separated by shoals of gravel and coarse sand, which were the principal obstructions to navigation in low-water, there being often on them at such seasons but a few inches of water. In some of the pools were found shallow places also obstructing navigation. There were also snags and loose rock in the channel. The navigation above Charleston was more obstructed than below. Above, it was almost suspended in summer. The coal and salt were generally sent out on rises, which enabled the boats to pass safely over the obstructions, which otherwise would stop their movements entirely. The use of the river for the movement of these valuable products was therefore unsatisfactory and intermittent. By the agency and superintendence of a board acting under the authority of the State, first of Virginia and then of West Virginia, considerable improvement in the river was from time to time effected, tolls being charged on the commerce for payment of expenses.

The object of the improvement begun several years ago by the United States, was to give a constant navigable depth of at least 6 feet throughout the whole length of the Kanawha to its mouth at the Ohio River, to be accomplished by large locks and dams. Those already built have been 350 by 50 feet. The peculiarity of most of the dams is that they can be lowered when the stage of water in the river will suffice over the shoals. This gives them the name of "movable dams," and enables an open river to be had when the water is high enough. The dams above Paint Creek, including that one which is No. 3 in the series, reckoning down stream, are fixed, as the declivity of the river is too great to permit the advantageous use of the movable system in that section.

The amount expended on the project outlined above was $868,680.32 up to June 30, 1880. Locks and dams 4 and 5 (movable), respectively 9⅛ and 15¼ miles above Charleston ferry, were finished and working in an entirely satisfactory manner. They are the first of their kind in the United States, or in America it is believed. At lock 3 at Paint Creek, 21½ miles above Charleston, two-thirds of the masonry was in place.

The expenditure during the year ending June 30, 1881, has been $152,701.44. Lock 3 has been essentially finished and the dam was well forward. It is expected to complete both lock and dam before the end of 1881. Lock 6, 4 miles below Charleston ferry, is under contract and begun. The engagement of the contractors requires completion in 1882. It is proposed to continue operations as rapidly as the available funds and the varying and uncertain state of the river will allow, to the completion of lock and dam No. 3, to operating locks and dams 4 and 5, to continuing operations at No. 6, and the acquisition of site No. 2, and beginning the lock there.

Experience has now shown that the estimated cost of each site, with its lock, dam, and appurtenances, was correctly placed at $350,000. As, in order to proper progress, at least one new site should be occupied each year, this sum of $350,000 is the least that should be appropriated in each year for such progress. It is plain, however, that as the whole system could be completed in the same time as any one of the similar parts, by far the most advantageous course looking to the utilization of the whole improvement, whose benefits cannot be fully realized until it covers the whole river, would be to make available the whole remainder of the estimate for completion $2,250,000. The whole work could then be finished, probably in two, certainly in three years.

If it were certainly known to the engineer in charge that $750,000 could be available for each of the next three years, the case would be the same as if the whole sum of $2,250,000 were appropriated at one time. While attention is earnestly called to this statement, request is only made (in the formal estimate) for the minimum sum mentioned.

The original estimate for the work did not include the care and operation of the locks and dams as completed. It was supposed these expenses would be covered in the usual way, by the collection of tolls on the freight passing through and using the improved channels. In accordance with this idea a project for such maintenance was prepared for the consideration of Congress. This was printed in the last annual report (see page 684). Congress did not adopt this view, but directed the cost of maintenance to be paid from the regular appropriation. The expense of the work to the United States is thus increased.

July 1, 1880, amount available	$273,319 68	
Amount appropriated by act approved March 3, 1881	200,000 00	
		$473,319 68
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		152,701 44
July 1, 1881, amount available		320,618 24
Amount (estimated) required for completion of existing project		2,250,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		350,000 00

(See Appendix G 22.)

23. *Elk River, West Virginia.*—The Elk is one of the chief tributaries of the Great Kanawha. Its course is tortuous, as is shown by the fact that the distance from its mouth to Braxton Court-House is 54 miles in a straight line, but 100 miles by the windings of the stream. The average low-water width is about 200 feet, with narrows at the rapids of about 150 feet in width, and occasional portions of about 300 feet in width. The pools vary in depth from 3 to 10 feet and are separated by rapids over shoals of cobble-stones and gravel on which there has been, at low seasons, a depth of but a few inches of water. The average fall, per mile, in the river from Braxton Court-House down is about 2½ feet, but is not uniformly distributed, being greatest (about 4 feet per mile) in the central section, and less (about 2 feet) in the upper and lower sections. Freshets of small height are of frequent occurrence, but rapidly pass off. The annual rise in the spring is about 10 or 12 feet. An extraordinary rise is sometimes had of 25 or 30 feet, but the duration is not great. The navigation of the river is mainly by batteaux.

The project of improvement estimated for, was for the continued use of these boats, bettering the water-way for them by cutting sluices through shoals from 10 to 12 feet wide, at low-water; and by removing rocks, snags, overhanging trees, &c. The cost of this improvement was estimated to be $100,000. An estimate was also made for slack watering the river at a cost of $1,000,000. This may have seemed absurd to some, but in Europe a river as valuable as the Elk would long ago have been so improved, and, doubtless, the day will come when it will be so in this country.

The amount expended up to June 30, 1880, was $3,702.22. The improvement effected was described in detail in the annual report for 1880 (see pages 692, 693, and 694). The operations were in conformity to the approved project and were applied to forty-two obstructions between Braxton Court-House and the Big Sandy. There were removed by blasting 3,100 cubic yards of rocks; 674 snags, trees and logs were cut away; about 2,000 cubic yards of loose rock were cleared out of the channels and laid in training-walls.

The amount expended in the year ending June 30, 1881, was $3,190.80. Nineteen bars were improved. There were broken up and removed 3,850 cubic yards of rock from places where it was an obstruction, and put in others where it was either not hurtful or where it was beneficial by giving better direction to the current. For 75 miles above the mouth of the river, boats and rafts can be run out on rises from 12 to 18 inches less in height than formerly.

The season of work is that of low-water and is necessarily short. The expenditure of each year is therefore small on the present scale of operations.

The amount that can be profitably expended in the year ending June 30, 1883, is $3,500, which would be applied in continuation of the plan of improvement previously indicated.

July 1, 1880, amount available	$6,297 78	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$11,297 78
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		3,190 80
July 1, 1881, amount available		8,106 98
Amount (estimated) required for completion of existing project		85,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		3,500 00

(See Appendix G 23.)

24. *Cape Fear River, North Carolina.*—The original condition of the entrance to Cape Fear River before the opening of the New Inlet in 1761, according to the rather uncertain information obtained from old maps, was that of a good channel over the bar and shoals of 14 feet depth at low-water in the Bald Head Channel, in about the same position as that of the present channel. The position and depths of the Smithville Harbor were about as they have ever since remained. The depth at the Horse Shoe Shoals appears to have been about 12 feet. The earliest information as to the upper river, from Campbell's Island to Wilmington, is that there were shoals in several places where there was not more 7½ feet depth at low-water.

After the opening of the New Inlet there was a gradual deterioration at the Bald Head Channel, and variable conditions in the Rip Channel and bar and in the New Inlet Bar. There are no certain records before 1839, when the survey of Lieutenant Glynn shows 9 feet at the Bald Head Channel, 9 feet at the Western or Rip Channel, and 10 feet at the New Inlet.

The Coast Survey chart of 1851 shows the low-water depth at Bald Head Channel 8 feet; the Western Channel, 7 feet; and New Inlet Bar, 8 feet. The Coast Survey chart of 1866 does not show much change, the available depths appearing to be about the same. A careful survey made by Mr. Vinal, of the Coast Survey, in 1872, shows 9 feet at low-water at the Bald Head Channel, and the same depth at the Rip, and 10 feet at the New Inlet Bar. No changes appear to have occurred in the upper river till improvements were made.

The improvement of the river below Wilmington was begun by the State of North Carolina, and continued from 1823 to 1828. In 1829 it was taken in hand by the United States, and from 1829 to 1838, inclusive, Congress made annual appropriations amounting to $202,539, which were expended in improving the river from Wilmington to Campbell's Island, about 9 miles below. The operations consisted mostly of pile and plank jetties made to concentrate the currents. Some dredging was also done. The plans initiated by the State were continued by the

United States. An available increase of about 2 feet in depth was obtained, so that 9 to 9½ feet could be carried at low-water.

Projects for improvement were revived in 1852 when Congress appropriated $20,000, and $140,000 was appropriated in 1854. These appropriations were expended for the improvement at the entrance by jetties at Bald Head Point, and by closing the breaches between Smith's and Zeke's islands. When the latter works were nearly completed, and the appropriation exhausted, a great storm in September, 1857, destroyed to a considerable extent the works at Zeke's Island, leaving the stone foundations only. Nothing further was done towards improvement till 1870, when the work began again.

The project adopted in 1870 was the closure of the breaches between Smith's and Zeke's islands, with the ultimate closure of the New Inlet in view. In 1873 and 1874 the additional work projected was the dredging of the new channel behind the Horse Shoe Shoals near Snow's Marsh, and dredging the Bald Head Channel (which had already begun to improve), and also dredging and removing obstacles in the river between Campbell's Island and Wilmington, so as to obtain 12 feet depth at mean low-water. In 1875 the work of closing the New Inlet was begun in earnest.

The amount expended on these projects from 1870 to the close of the fiscal year ending June 30, 1880, was $1,042,390.55.

July 1, 1880, there was a channel of 13 feet depth at mean low-water across the bar and shoals of the Bald Head Channel.

The least depths on the Horse Shoe Shoals were 11 feet, and thence to Wilmington the least depth was 12 feet. At present the depth has been increased to 14 feet on the Bald Head Channel, and no diminution has occurred elsewhere. The available width at Bald Head has also increased. Vessels drawing 14½ feet of water can at ordinary spring tides be carried from Wilmington to Smithville, and 18 feet draught from thence to the sea.

The early completion of the channel of 16 feet depth at low-water is highly necessary for the interests of commerce and navigation. It can be more economically done if done quickly. It can be fully completed by the close of the fiscal year ending June 30, 1883, if the funds are available.

The amount expended in the fiscal year ending June 30, 1881, is $89,559.13, with the results indicated above. An appropriation of $140,000 was made by Congress, March 3, 1881, which it is proposed to expend mainly in dredging the Snow's Marsh Channel through from deep water above Price's Creek to 16 feet in depth above Rives's Point.

It is estimated that to complete the 16-foot channel to Wilmington, continue operations of suction dredge, and to provide for contingencies will cost $410,000 in addition to the amount now available. It is very desirable that the whole sum be given at once, in order that the full advantages of the improvement may be realized as soon as possible.

July 1, 1880, amount available	$95,109 45	
Amount appropriated by act approved March 3, 1881	140,000 00	
		$235,109 45
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		89,559 13
July 1, 1881, amount available		145,550 32
Amount (estimated) required for completion of existing project		410,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		300,000 00

(See Appendix G 24.)

EXAMINATIONS AND SURVEYS.

To comply with the provisions of the river and harbor act of June 14, 1880, Lieutenant-Colonel Craighill was charged with and has completed examinations and surveys as stated below:

1. *The bars at the entrance of Annapolis Harbor, with a view to ascertain the character of jetties necessary to render the proposed improvement permanent.* (See Appendix G 8.)
2. *Chester River, between Kirby's Landing and Spry's Landing, Maryland.* (See Appendix G 4.)
3. *Water passage between Deal's Island and Little Deal's Island, Maryland.* (See Appendix G 13.)

Reports of the results of the above were transmitted to Congress and printed as Senate Executive Document No. 40, Forty-sixth Congress, third session.

In response to a Senate resolution of December 13, 1880, Lieutenant-Colonel Craighill made an estimate of the *cost of deepening the entrance to Saint Jerome's River, in Maryland, so as to make it an available harbor.* This report, dated December 16, 1880, was transmitted to Congress and printed as Senate Executive Document No. 37, Forty-sixth Congress, third session. (See Appendix G 25.)

To comply with the provisions of the river and harbor act of March 3, 1881, Lieutenant-Colonel Craighill has been charged with and is now engaged upon the following, which will be duly submitted when received:

1. *The channel of Broad Creek on the west side of Kent Island, Maryland.*
2. *Corsica Creek, Maryland.*
3. *Upper thoroughfare leading into Tangier Sound, Deal's Island, and Rock Creek, Maryland*
4. *For a further survey of James River for the purpose of ascertaining the practicability and cost of procuring a channel of 25 feet at full tide from Richmond to the mouth of the river.*
5. *Skipton Creek, Maryland.*
6. *Bush River, Maryland, from Harford Furnace to Chesapeake Bay.*

To comply with one of the provisions of the sundry civil bill of March 3, 1881, Lieutenant-Colonel Craighill was placed in charge of and is now engaged upon the *surveys across the peninsula of Maryland and Delaware for the purpose of establishing a connection by canal between the waters of the Chesapeake and Delaware Bays.*

The results of this survey will be duly submitted when received.

IMPROVEMENT OF THE HARBORS AT WASHINGTON AND GEORGETOWN, DISTRICT OF COLUMBIA; AND AT BRETON BAY AND SAINT JEROME'S CREEK, MARYLAND; OF THE CHANNEL AT MOUNT VERNON, VIRGINIA; OF RAPPAHANNOCK RIVER; OF TRIBUTARIES OF THE LOWER POTOMAC, AND OF CERTAIN RIVERS IN VIRGINIA AND NORTH CAROLINA.

Engineer in charge, Mr. S. T. Abert, United States Civil Engineer.

1. *Harbors at Washington and Georgetown, District of Columbia.*—The operations connected with the improvement of these harbors, since its inception in 1871, have been directed to securing and maintaining a navigable channel from near Giesborough Point to Easby's Point, 200 feet wide and 16 feet deep at low-water; to the removal of rocks in Georgetown Harbor, and, within the past two years, to securing a channel along the Washington wharves.

The excavation of the last-named channel was made in accordance with the requirements of the act of March 3, 1879, that the appropriation should be "so expended as to produce the greatest immediate benefit to navigation and commerce."

The amount expended to June 30, 1881, is $171,140.80, and has resulted in securing—

1. A channel through the bar, above the Long Bridge, 200 feet wide and 15 feet deep; completed in December, 1871.
2. A redredging of the same channel (which in three years had filled in to a depth of 10 feet) 200 feet wide and 15 to 16 feet deep; completed in April, 1875.
3. A channel through the bar near Giesborough Point, 200 feet wide and 15 to 16 feet deep; completed in June, 1875.
4. A second redredging of the channel through the bar above the Long Bridge (which had again filled in to a depth of about 10 feet), 200 feet wide and 16 feet deep; completed in April, 1880.
5. The removal of three rocks, comprising 522 cubic yards, from Georgetown Harbor.
6. A channel along the Washington wharves, 200 feet wide and 12 feet deep, afterwards deepened to 15 feet, for a width of 75 feet next the wharves, which latter dimensions were carried down to 15 feet water about midway of the arsenal grounds; completed in May, 1880.

The appropriation of June 14, 1880, has not yet been applied to work, owing to the inability of the contractor to find a dumping-ground in accordance with the terms of the contract; and for this reason the contract was annulled.

It is proposed to apply this appropriation, together with that of March 3, 1881, to widening the Washington Channel and removing rocks in Georgetown Harbor.

The engineer in charge recommends an appropriation of $50,000 for continuing the removal of rocks in Georgetown Harbor and at the outlet lock and inclined plane of the Chesapeake and Ohio Canal, above Georgetown; and an appropriation of $100,000 for continuing the widening of the Washington Channel, with a view of making a winter harbor as a part of the plan which he has heretofore discussed for the general improvement of these harbors, which plan is in general conformity to that of the Board of 1872.

July 1, 1880, amount available	$75,227 92	
Amount appropriated by act approved March 3, 1881	50,000 00	
		$125,227 92
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,359 61	
July 1, 1881, outstanding liabilities	70 30	
		4,429 91
July 1, 1881, amount available		120,798 01
Amount (estimated) required for completion of existing project		240,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		150,000 00

(See Appendix H 1.)

2. *Channel at Mount Vernon, Virginia.*—The present project for the improvement of this channel was adopted in 1879, the object being to excavate a channel from deep water of the Potomac River to the wharf at Mount Vernon, 150 feet wide and 6 to 7 feet deep at low-water, with a turning-basin at the wharf. The least depth before the improvement was 4 feet.

The amount expended to June 30, 1881, is $6,993, which has resulted in securing a channel 110 feet wide and 9 feet deep, in center, from the

Potomac Channel to the wharf, and a circular turning-basin at the wharf, of the same depth, and of 150 feet radius.

The appropriation of $5,500 asked for is to be applied to widening the channel and enlarging the turning-basin.

July 1, 1880, amount available	$3,043 57	
Amount appropriated by act approved March 3, 1881	1,500 00	
		$4,543 57
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	3,036 75	
July 1, 1881, outstanding liabilities	6 30	
		3,043 05
July 1, 1881, amount available		1,500 52
Amount (estimated) required for completion of existing project		5,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		5,500 00

(See Appendix H 2.)

3. *Neabsco Creek, Virginia.*—The river and harbor act of March 3, 1881, appropriated $5,000 for the improvement of this creek. The project contemplates dredging a channel from 7 feet water in the Potomac River to Atkinson's Upper Landing, including a channel to Atkinson's Lower Landing and Willis's Wharf, a distance of about 14,800 feet.

The work has been offered for contract, the proposals to be opened in July, 1881.

For continuing the improvement an appropriation of $20,000 is recommended for the year ending June 30, 1883.

Amount appropriated by act approved March 3, 1881		$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$2 00	
July 1, 1881, outstanding liabilities	9 63	
		11 63
July 1, 1881, amount available		4,988 37
Amount (estimated) required for completion of existing project		51,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		20,000 00

(See Appendix H 3.)

4. *Breton Bay, Leonardtown, Maryland.*—The present project for this improvement was adopted in 1878, the object being to excavate a channel 150 feet wide and 9 feet deep, between the 9-foot water in the bay and the Leonardtown Wharf. The least depth previous to the improvement was 5 feet.

The amount expended to June 30, 1881, is $11,984.84, which has resulted in securing a channel 115 feet wide, for a distance of 2,700 feet, and 40 feet wide for a further distance of 400 feet, and a basin at the wharf 400 feet long and 290 feet wide, all to a depth of 9 feet at low-water.

The appropriation of $15,000 asked for is to complete this improvement, and will be applied to widening the channel and extending it to 9 feet water in the bay.

July 1, 1880, amount available	$3,116 40	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$6,116 40
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		3,101 24
July 1, 1881, amount available		3,015 16
Amount (estimated) required for completion of existing project		15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		15,000 00

(See Appendix H 4.)

5. *Nomini Creek, Virginia.*—The present project for the improvement of this creek was adopted in 1873, the object being to excavate a channel through the bar at its mouth 100 feet wide and 9 feet deep at low-water, and modified in 1879 so as to provide for a width of 150 feet.

The depth upon the bar before the improvement was begun was 3 feet. The amount expended to June 30, 1881, is $28,485.91, which has resulted in securing a channel 100 feet wide and 9 to 10 feet deep at low-water, from the bay to deep water within the bar.

The engineer in charge recommends a widening of the channel to 150 feet to secure its permanency, and the dredging of a training-channel todivert a cross current detrimental to the integrity of the main channel.

The engineer bases upon later examinations an estimate of $20,407, required to complete the improvement, and recommends an appropriation of $10,000 for the year ending June 30, 1883.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	2,000 00	
		$7,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,985 91	
July 1, 1881, outstanding liabilities	9 63	
		4,995 54
July 1, 1881, amount available		2,004 46
Amount (estimated) required for completion of existing project		20,470 00
Amount tha tcan be profitably expended in fiscal year ending June 30, 1883.		10,000 00

(See Appendix H 5.)

6. *Saint Jerome's Creek, Maryland.*—The river and harbor act of March 3, 1881, appropriated $6,500 for this improvement.

The project contemplates dredging a channel 100 feet wide and 9 feet deep at low-water through the outer bar; and a channel 40 feet wide and 6 feet deep through the south prong of the creek, the material therefrom to be thrown up into a dike so as to form a pond of a portion of the south prong, for the purposes of the United States Fish Commission.

The amount expended to June 30, 1881, is $4,921.48, with which progress in both these channels has been made.

The amount required for the completion of this project is $15,000, and an appropriation of that amount is recommended for the year ending June 30, 1883.

Amount appropriated by act approved March 3, 1881	$6,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,921 48
July 1, 1881, amount available	1,578 52
Amount (estimated) required for completion of existing project	15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	15,000 00

(See Appendix H 6.)

7. *Rappahannock River, Virginia.*—The present project for the improvement of this river was adopted in 1871, and modified in 1879, the object being to provide a channel 150 feet wide and 10 feet deep through the bar at Fredericksburg; channels 100 feet wide and 10 feet deep through four bars between Fredericksburg and Port Royal; and channels 200 feet wide and 15 feet deep through two bars below Port Royal.

The amount expended to June 30, 1881, is $101,344.23. This expenditure has resulted in securing, by means of dredging at various times and the construction of 8,722 linear feet of dike, navigable channels at

Fredericksburg and at Spottswood Bar, and the removal of wrecks, drift logs, and snags at other points.

The engineer in charge presents a revised estimate, based on recent examinations, for the completion of the improvement as far down as Farley Vale Bar.

The amount asked for, to be applied to this purpose during the year ending June 30, 1883, is $34,000.

July 1, 1880, amount available	31,835 13	
Amount appropriated by act approved March 3, 1881	15,000 00	$46,835 13
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	17,324 02	
July 1, 1881, outstanding liabilities	862 51	18,186 53
July 1, 1881, amount available		28,648 60
Amount (estimated) required for completion of existing project		222,345 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		34,000 00

(See Appendix H 7.)

8. *Totuski River, Virginia.*—The appropriation of June 14, 1880, ($2,500), was found too small to accomplish economic results, and work was deferred to the following year when the appropriation of $2,500, by act of March 3, 1881, justified advertisement for proposals. This has been done, the proposals to be opened in July, 1881.

The engineer in charge submits a revised estimate, based upon a late examination for completing the improvement at Booker's Bar, and dredging a channel through the bar at the mouth of the river.

For the former, he asks $17,000 for the next fiscal year.

July 1, 1880, amount available	$2,500 00	
Amount appropriated by act approved March 3, 1881	2,500 00	$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	45 00	
July 1, 1881, outstanding liabilities	9 19	54 19
July 1, 1881, amount available		4,945 81
Amount (estimated) required for completion of existing project.		29,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		17,000 00

(See Appendix H. 8.)

9. *Urbana Creek, Virginia.*—The present project for the improvement of this creek was adopted in 1879, the object being to excavate a channel through the bar at the mouth of the creek 150 feet wide and not less than 10 feet deep. The least depth of water on this bar was 6½ feet.

The amount expended to June 30, 1881, is $4,923.74, which has resulted in securing a channel 80 feet wide and 10 feet deep at low-water.

The work under the appropriation of March 3, 1881 ($4,000), has been offered for contract, and proposals will be opened in July, 1881.

The engineer in charge asks for the completion of this work an appropriation of $8,500 for the year ending June 30, 1883.

July 1, 1880, amount available	$2,636 66	
Amount appropriated by act approved March 3, 1881	4,000 00	$6,636 66
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		60 44
July 1, 1881, amount available		6,576 22

Amount (estimated) required for completion of existing project	8,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	8,500 00

(See Appendix H 9.)

10. *Mattaponi River, Virginia.*—The present project for the improvement of this river was adopted in 1880, the object being to provide a channel 40 feet wide and 5½ feet deep at low-water, by the removal of snags, drift, wrecks, and overhanging trees, and by dredging through the bars.

The amount expended to June 30, 1881, is $1,444.09, which has resulted in securing an efficient plant for snagging operations, ready for active work which is about to be begun at Ayletts.

The appropriation of $10,000 recommended is to be applied to continuing the improvement.

July 1, 1880, amount available	$2,500 00	
Amount appropriated by act approved March 3, 1881	3,300 00	
		$5,800 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		1,444 09
July 1, 1881, amount available		4,355 91

Amount (estimated) required for completion of existing project	28,300 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	10,000 00

(See Appendix H 10.)

11. *Pamunkey River, Virginia.*—The present project for the improvement of this river was adopted in 1880, the object being to provide a channel 40 feet wide and 5 to 6 feet deep at low-water, by the removal of snags, drift, wrecks, and overhanging trees, and by dredging through the bars.

The amount expended to June 30, 1881, is $2,449.81, which has resulted in securing an efficient plant for snagging operations, and the improvement of 4 miles of the river at the upper limit of the improvement.

The appropriation of $12,500 asked for is to be applied to continuing the snagging operations.

July 1, 1880, amount available	$2,500 00	
Amount appropriated by act approved March 3, 1881	2,500 00	
		$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,448 81
July 1, 1881, amount available		2,551 19

Amount (estimated) required for completion of existing project	12,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	12,500 00

(See Appendix H 11.)

12. *York River, Virginia.*—The present project for the improvement of this river was adopted in 1880, the object being to provide a channel by dredging 22 feet deep and 200 feet wide (to be increased afterwards to 400 feet wide) through the bar opposite the mouth of Potopotank Creek, and the bar immediately below and at West Point, and a basin of same depth at the wharves at West Point.

The first appropriation for this improvement was made June 14, 1880, of $10,000, with which the improvement of the bar at mouth of Potopotank Creek was effected.

The amount expended to June 30, 1881, is $10,853.12, and has resulted in securing a channel 105 feet wide and 22 feet deep through Potopotank Bar, and a thorough survey of the bar at and next below West Point.

An appropriation of $50,000 is asked for to continue the improvement at West Point during the fiscal year ending June 30, 1883.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	25,000 00	
		$35,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	10,853 12	
July 1, 1881, outstanding liabilities	48 00	
		10,901 12
July 1, 1881, amount available		24,098 88
Amount (estimated) required for completion of existing project		93,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		50,000 00

(See Appendix H 12.)

13. *Chickahominy River, Virginia.*—The present project for the improvement of this river was adopted in 1878, the object being to dredge channels 100 to 150 feet wide through Binn's, Old Fort and Windsor Shades bars to a depth of not less than 8 feet at low-water; and to remove snags, drift, &c., from points above, and close subsidiary channels by means of dikes. The least depths on these bars were 4 and 5 feet at low-water.

The amount expended to June 30, 1881, is $7,976.35, which has resulted in affording a channel through Binn's Bar 150 feet wide and 8 feet deep, and through each of the other bars 100 feet wide and 8 feet deep.

An appropriation of $5,000 is asked to complete the improvement during the year ending June 30, 1883.

July 1, 1880, amount available	$3,000 00	
Amount appropriated by act approved March 3, 1881	2,000 00	
		$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,976 35
July 1, 1880, amount available		2,023 65
Amount (estimated) required for completion of existing project		5,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		5,000 00

(See Appendix H 13.)

14. *Staunton River, Virginia.*—The present project for the improvement of this river between Roanoke Station and Brookneal was adopted in 1879, the object being to secure a navigable channel not less than 35 feet wide and 2 feet deep through the ledges and sand-bars, and a slope of water-surface at the rapids not greater than 10 feet to the mile.

The amount expended to June 30, 1881, is $8,534.37, which has resulted in securing a survey of the river from Brookneal to Roanoke Station; the construction of boats and derrick; and the improvement of Hawk Mountain Shoal, with some progress at Horseback Shoal, and between Clark's Dam and Roanoke Station.

An appropriation of $15,000 is asked to continue the improvement during the year ending June 30, 1883.

July 1, 1880, amount available	$8,602 38	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$13,602 38
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		4,636 75
July 1, 1881, amount available		8,965 63

Amount (estimated) required for completion of existing project	40,170 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	15,000 00

(See Appendix H 14.)

15. *Dan River, between Madison, North Carolina, and Danville, Virginia.*—The present project for this improvement was adopted in 1880, the object being to afford a channel for navigation, not less than 35 feet wide, and not less than 1½ feet deep in the pools, and 2 feet deep in the rapids at extreme low-water. It is believed that these depths of excavation will give for six months of the year a channel of not less than 3 feet.

The amount expended to June 30, 1881, is $4,989.11, and has resulted in securing derrick-boats, scows, &c., as a working outfit, and fair progress in the improvement of Long Shoal, above Danville, Va.

An appropriation of $15,000 is recommended for continuing the improvement during the year ending June 30, 1883.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	8,000 00	
		$18,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		4,989 11
July 1, 1881, amount available		13,010 89
Amount (estimated) required for completion of existing project		34,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		15,000 00

(See Appendix H 15.)

16. *French Broad River, North Carolina.*—The present project for the improvement of this river was adopted in 1878, the object being to afford a channel 35 feet wide and not less than 2½ feet deep at low-water, between Brevard and Big Buck Shoal, a distance of 31½ miles.

The amount expended to June 30, 1881, is $33,802.91, which has resulted in securing a channel of the required dimensions for a distance of 16 miles below Brevard.

For the completion of the improvement $17,000 will be required, and an appropriation of that amount is recommended for the year ending June 30, 1883.

July 1, 1881, amount available	$4,258 12	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$9,258 12
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		5,272 23
July 1, 1881, amount available		3,985 89
Amount (estimated) required for completion of existing project		17,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		17,000 00

(See Appendix H 16.)

17. *Roanoke River, North Carolina.*—The project for the improvement of this river was adopted in 1871, the object being to improve the navigation by the removal of rocks near Weldon and Halifax, and of wrecks, snags, and overhanging trees at various points, and dredging channels through bars and shoals.

The amount expended to June 30, 1878, (since which time no funds have been available) was $45,000.

The engineer in charge recommends a survey to ascertain the changes which have taken place since the survey of 1871, upon which the present estimates are based; and for the removal of snags, and the repair of dike at McCree's Landing an appropriation of $5,000 is recommended for the year ending June 30, 1883.

Amount that can be profitably expended in fiscal year ending June 30, 1883..	$5,000 00

(See Appendix H 17.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with provisions of the river and harbor act of June 14' 1880, Mr. Abert was charged with and has completed the following:

1. *Neabsco Creek, a tributary of the Potomac.* (See Appendix H 3.)
2. *Potomac River at the mouth of Pohick Creek.* (See Appendix H 18.)
3. *Mouth of Currioman Bay, Virginia.* (See Appendix H 19.)
4. *The Nomini River, from the ferry across the same to the head of tidewater.* (See Appendix H 5.)

The results of these surveys were submitted to Congress and printed in House Ex. Doc. No. 41, Forty-sixth Congress, third session.

And to comply with provisions of the river and harbor act of March 3, 1881, he has been charged with the following, the results of which will be duly transmitted when received:

1. *Staunton River, from Brookneal, in Campbell County, to mouth of Pig River, Virginia.*
2. *Roanoke River, from Weldon, North Carolina, to Clarksville, Virginia.*
3. *Potomac and Anacostia Rivers, in vicinity of Washington, District of Columbia, with reference to improvement of navigation; the establishment of harbor line; and raising of flats, so far as their improvement may be necessary to the improvement of navigation and the establishment of the harbor line.*
4. *Upper Machodoc Creek, Virginia, a tributary of Potomac River.*
5. *Urbana Creek, Virginia, a tributary of Rappahannock, from the village of Urbana to the Oaks.*

IMPROVEMENT OF THE HARBORS OF NORFOLK, VIRGINIA, AND BEAUFORT, NORTH CAROLINA; OF CURRITUCK SOUND, COANJOK BAY, AND NORTH RIVER AND BAR, AND OF CERTAIN RIVERS IN VIRGINIA AND IN NORTH CAROLINA AND SOUTH CAROLINA.

Officers in charge, Capt. C. B. Phillips, Corps of Engineers, until his death, June 14, 1881; since which time, Capt. James Mercur, Corps of Engineers.

1. *Harbor at Norfolk, Virginia, and its approaches.*—Work during the fiscal year has been conducted in furtherance of existing project for the improvement of the harbor and its approaches. The improvement was commenced in 1877, the first appropriation having been made in 1876, since which to the end of the fiscal year, $184,719.59 has been expended on the work.

Owing to the difficult work encountered at the Portsmouth flats, the contractors had not completed their work on June 30, 1880, and were granted an extension. They finished it on August 11, 1880; 64,385 cubic yards of material and 150 scow loads of piles, wharf *débris*, &c., having been removed under the appropriation of March 3, 1879.

Under the appropriation of June 14, 1880, about 237,000 cubic yards of material have been removed, leaving about 113,000 cubic yards yet to be dredged. The time for completion of contract has been extended to October 31, 1881.

The result of the work of the fiscal year has been to extend the channel at Western Branch bar through some lumps found below, total length now 4,400 feet, width 265 feet, depth at mean low-water not less than 25 feet; to make one cut 35 feet wide through Sewall's Point bar 14,000 feet long, and another cut two-thirds of the distance and same width, both to 25 feet depth or more, at low-water.

The act of March 3, 1881, appropriated $75,000 for this work. A small portion of this will be devoted to completing the dredging at Portsmouth flats and in removing a few small lumps from the channel of the South Branch up to the U. S. Navy Yard.

A portion will also be devoted to dredging in the Eastern Branch above the county bridge; the bulk, however, will be devoted to dredging in the approaches to the harbor, to secure a channel not less than 25 feet deep at low-water, and ultimately 500 feet wide, from Hampton Roads to the inner harbor.

July 1, 1880, amount available	$64,460 24	
Amount appropriated by act approved March 3, 1881	75,000 00	
		$139,460 24
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	29,662 17	
July 1, 1881, outstanding liabilities	9,516 66	
		39,178 83
July 1, 1881, amount available		100,281 41
Amount (estimated) required for completion of existing project		93,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		93,000 00

(See Appendix I 1).

2. *Archer's Hope River, Virginia.*—The river and harbor act of March 3, 1879, directed an examination or survey of this river. The survey was made and a report, with estimate of cost of improvements proposed, transmitted to Congress.

It was proposed to secure a channel 50 feet wide and 6 feet deep from the mouth of the river where it empties into the James River to the City of Williamsburg, some 4 or 5 miles above, by dredging at several points.

Two plans were submitted; the total estimated cost of one was $19,400, of the other $13,571.

The act of March 3, 1881, appropriated $5,000 for this work. It is proposed to expend this amount in dredging, to carry out one of the plans proposed, and, as much of the work to be done is common to both plans, the decision as to which shall ultimately be adopted will, for the present, be deferred. The amount asked for is for the completion of the first-mentioned project.

Amount appropriated by act approved March 3, 1881	$5,000
July 1, 1881, amount available	5,000
Amount (estimated) required for completion of existing project	14,400
Amount that can be profitably expended in fiscal year ending June 30, 1883..	14,400

(See Appendix I 2.)

3. *Pagan Creek, Virginia.*—The appropriation of $5,000 of June 14, 1880, was the first made for this work. According to the general plan of improvement, it is being applied to dredging a channel 60 feet in width and 8 feet in depth through three of the four obstructing bars between the town of Smithfield and the mouth of the creek.

The commencement of the work was delayed by various causes until May 30, since which time 6,662 cubic yards of material have been removed.

The appropriation of $5,000 (act March 3, 1881) will also be devoted to dredging in the bars mentioned.

The work is being executed by contract.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	55 53	
July 1, 1881, outstanding liabilities	1,237 31	
		1,292 84
July 1, 1881, amount available		8,707 16
Amount (estimated) required for completion of existing project		18,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		18,000 00

(See Appendix I 3.)

4. *Blackwater River, Virginia.*—Under the appropriation, $3,500, of June 14, 1880, the cutting off of obstructing points in accordance with approved project was continued.

The point at Franklin was cut back some 74 feet, about 6,000 cubic yards of material being removed, and put back from 20 to 150 feet from the river. About 90 linear feet of sheet-pile revetment was driven to protect the bank at this point. At Littletown Bend the point was cut back about 60 feet and about 12,000 cubic yards of material removed and put back, as at Franklin.

The river and harbor act of March 3, 1881, appropriated $1,500 for continuing this work. It is proposed to expend this amount in cutting off projecting points which now interfere with navigation as far as funds will permit.

July 1, 1880, amount available	$3,731 26	
Amount appropriated by act approved March 3, 1881	1,500 00	
		$5,231 26
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		3,740 90
July 1, 1881, amount available		1,490 36
Amount (estimated) required for completion of existing project		2,350 00
Amount that can be profitably expended in fiscal year ending June 30, 1883..		2,500 00

(See Appendix I 4.)

5. *Nottoway River, Virginia.*—The acts of June 14, 1880, and March 3, 1881, appropriated together $7,000 for this work.

A project for the expenditure of this sum, which has been approved, contemplates the clearing of the river, commencing at the mouth and working up stream, so far as funds will permit. A small amount of cheap diking may be required at some points, and it is expected that the improvements projected will secure a depth of from 4 to 5 feet during about nine months of the year.

There has been some delay in the commencement of operations, owing to the necessity of opening a passage for the machinery through four bridges without draws; it is believed now, however, that all difficulty in this connection has been overcome.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	2,000 00	
		$7,000 00
July 1, 1881, amount available		7,000 00
Amount (estimated) required for completion of existing project		2,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883..		2,000 00

(See Appendix I 5.)

6. *North Landing River, Virginia and North Carolina.*—Operations during the year have been conducted with a view of carrying out the general plan of improvement adopted in 1879, which was to secure a

channel 80 feet wide at bottom and 9 feet deep, by dredging where these dimensions did not exist, also to trim the banks of overhanging trees, clear the channel of logs and snags, and cut off some projecting points at abrupt bends.

Under the appropriation of June 14, 1880, the channel through Blackwater Flats, which at the close of the last fiscal year had a varying width of from 35 to 60 feet, has been dredged for the full width of 80 feet for the entire length of 21,600 feet. This work was done by contract, and 64,354 cubic yards of material were removed.

The cutting off of obstructing points was continued with some interruptions to the close of the fiscal year. One point has been cut back 115 feet, and another one 32 feet; two short shoals in the channels have also been dredged.

The act of March 3, 1881, appropriated $7,500 for continuing this work. This will be applied to cutting off points, dredging short shoals, clearing out logs and snags, and trimming the banks of the upper river.

July 1, 1880, amount available	$16,432 31	
Amount appropriated by act approved March 3, 1881	7,500 00	
		$23,932 31
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$13,275 53	
July 1, 1881, outstanding liabilities	3,406 10	
		16,681 63
July 1, 1881, amount available		7,250 68
Amount (estimated) required for completion of existing project		40,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		25,000 00

(See Appendix I 6.)

7. *Currituck Sound, Coanjok Bay, North River and Bar, North Carolina.*—Operations during the year have been conducted with a view to carrying out the general plan of improvement originally adopted, which was to secure a channel 80 feet in width at bottom and 9 feet in depth at an ordinary winter stage of water through the entire length of the upper sound, a distance of 10½ miles. The work has been done by dredging. Two contracts called for the excavation of 350,000 cubic yards. Under them 236,517 cubic yards have been removed. The act of June 14, 1880, added Coanjok Bay to this work. No estimate having previously been made, an examination was made and estimate of cost submitted by the officer in charge. One cut has been made entirely through this bay, to relieve the pressing needs of commerce. The work accomplished during the fiscal year has been the cutting of a channel about 52 feet wide between beacons 5 and 6; the completion of the channel, about 50 feet wide, between beacons 6 and 7, and a channel varying from 25 to 100 feet in width between beacons 7 and 8.

The appropriation of March 3, 1881, includes North River, for which no estimate has been submitted. It is not expected that any work will be done on this river at present.

The appropriation will be applied to carrying out the original plan of improvement, supplemented by some work on Coanjok Bay.

July 1, 1880, amount available	$40,852 22	
Amount appropriated by act approved March 3, 1881	30,000 00	
		$70,852 22
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	29,120 63	
July 1, 1881, outstanding liabilities	6,430 78	
		35,551 41
July 1, 1881, amount available		35,300 81

Amount (estimated) required for completion of existing project	$40,213 95
Amount that can be profitably expended in fiscal year ending June 30, 1883.	40,200 00

(See Appendix I 7.)

8. *Scuppernong River, North Carolina.*—Work during the fiscal year has been confined to dredging through two obstructing points, known as the "thoroughfare" and "Devil's Elbow," under the appropriation of $1,000 of June 14, 1880, together with a small balance of previous appropriation.

A cut 23 feet wide was made through the first-named place, opening it for the passage of vessels. The cut through "Devil's Elbow" was not quite completed, owing to the near exhaustion of funds. About 1,800 cubic yards of material were removed.

The act of March 3, 1881, appropriated $1,000 for continuing this work. This amount will be applied to cutting off obstructing points so far as the funds will permit.

July 1, 1880, amount available	$1,576 26	
Amount appropriated by act approved March 3, 1881	1,000 00	
		$2,576 26
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,149 06	
July 1, 1881, outstanding liabilities	168 75	
		1,317 81
July 1, 1881, amount available		1,258 45
Amount (estimated) required for completion of existing project		2,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		2,000 00

(See Appendix I 8.)

9. *Pamplico and Tar Rivers, North Carolina.*—Work during the past fiscal year has consisted on the Pamplico, in the dredging of material and removal of stumps and roots from the channel across "Stumpy Shoal" about 1¼ miles below Washington, for the purpose of widening, deepening, and straightening it; 1,197 stumps and 2,235 cubic yards of material were removed.

On the Tar, the work has been the construction of jetties, 3,233 linear feet of which were built, and the removal of a large quantity of logs, snags, and overhanging trees.

The act of March 3, 1881, appropriated $8,000 for these rivers, which it is proposed to divide about equally between them and continue the same general plan of improvement which has been carried on the past two years.

The work on these rivers having exceeded in amount that originally estimated for, if it is considered desirable to continue the improvements, new examinations and estimates are necessary.

July 1, 1880, amount available	$9,255 61	
Amount appropriated by act approved March 3, 1881	8,000 00	
		$17,255 61
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	6,987 10	
July 1, 1881, outstanding liabilities	1,405 14	
		8,392 24
July 1, 1881, amount available		8,863 37
Amount that can be profitably expended in fiscal year ending June 30, 1883.		15,000 00

(See Appendix I 9.)

10. *Neuse River, North Carolina.*—Work during the fiscal year has been conducted in accordance with the approved project for the expenditure of the appropriation of June 14, 1880.

Previous appropriations had confined the work to below the railroad bridge near Goldsboro'. This one extended it to Smithfield, the head of navigation.

Above the bridge the work has consisted in the removal of logs, snags, and overhanging trees. This work has been done for 12 miles above the railroad bridge.

Below the bridge, about 5,000 linear feet of log and brush dike have been built at different points between "Pitch Kettle" and "Dear Neck," which are about 10 miles apart.

About 600 linear feet of dams were built to prevent the flow of water from the river into "Grindle Creek."

A bad bend at "Bull Point" has been revetted with logs, and the bank protected to prevent caving.

A number of sheet-pile jetties have also been constructed, the ends of which were secured by mattresses of logs and brush weighted with stone.

The survey of the river in 1871 was made during flush-water; many obstructions to navigation, which have since been removed, were not met with at the time. As they were not estimated for, the cost of improvement will be greater than was expected. It will probably require $30,000 to $40,000 more to complete the work than was originally estimated.

The act of March 3, 1881, appropriated $30,000 for continuing the work, which it is proposed to expend in carrying out the general plan of improvement, clearing out the river above and constructing jetties, with perhaps a little dredging below the railroad bridge.

July 1, 1880, amount available	$63,245 10	
Amount appropriated by act approved March 3, 1881	30,000 00	
		$93,245 10
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	30,387 57	
July 1, 1881, outstanding liabilities	7,991 58	
		38,379 15
July 1, 1881, amount available		54,865 95
Amount (estimated) required for completion of existing project		13,761 84
Amount that can be profitably expended in fiscal year ending June 30, 1883.		50,000 00

(See Appendix I 10.)

11. *Trent River, North Carolina.*—Operations have been conducted having in view to secure a navigable depth of 3 feet at all stages to Trenton, 43 miles from the mouth of the river.

The work has been the clearing of the river of snags and logs, and the banks of overhanging trees for the 29 miles from the mouth of the river to "Quaker Bridge." Between Quaker Bridge and Trenton a dredge has been employed and about 25,000 cubic yards of material, partially rock, has been removed.

The act of March 3, 1881, appropriated $5,000 for continuing this work. This will be applied to carrying out the original plan of improvement. It is, however, feared, as more work has been encountered than was estimated for, that it will be insufficient to complete the improvement.

July 1, 1880, amount available	$10,128 37	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$15,128 37
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	6,977 13	
July 1, 1881, outstanding liabilities	3,302 67	
		10,279 80
July 1, 1881, amount available		4,848 57
Amount that can be profitably expended in fiscal year ending June 30, 1883.		12,000 00

(See Appendix I 11.)

12. *Contentny Creek, North Carolina.*—An examination of this creek was directed by the river and harbor act of June 14, 1880, and a report with estimate amounting to $39,600 of cost of proposed improvement was transmitted to Congress.

The act of March 3, 1881, appropriated $10,000 for this work. It is proposed to expend this sum in clearing the creek of all obstructions, natural and artificial, carrying the work as far as funds will permit. Thus it is expected to secure a navigable depth of 3 feet for the 8 or 9 flush-water months of the year, from the mouth of the creek, where it empties into the Neuse River, to the town of Stantonsburg, some 70 miles above.

Amount appropriated by act approved March 3, 1881	$10,000 00
July 1, 1881, amount available	10,000 00
Amount (estimated) required for completion of existing project	30,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	15,000 00

(See Appendix I 12.)

13. *Beaufort Harbor, North Carolina.*—A survey of this harbor was made in November and December last, having been provided for in the river and harbor act of June 14, 1880, and a report with estimate of cost of improvement proposed was transmitted to Congress.

The improvement proposed consists in the construction of jetties of loose rock to prevent the further abrasion of Shackleford's Point and to dredge two channels and a turning-basin near the town of Beaufort.

The total estimated cost of the improvement was $82,103.

The act of March 3, 1881, appropriated $30,000 for this work, which it is proposed to expend in the carrying out of the plan above indicated deferring the commencement of the work until some more precise data regarding the location of jetties is obtained.

Amount appropriated by act approved March 3, 1881	$30,000 00
July 1, 1881, amount available	30,000 00
Amount (estimated) required for completion of existing project	52,103 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	52,100 00

(See Appendix I 13.)

14. *Cape Fear River, between Wilmington and Fayetteville, North Carolina.*—An examination or survey of this portion of the Cape Fear was directed by the river and harbor act of June 14, 1880.

An examination was made and report with partial estimate of cost of improvement proposed was transmitted to Congress.

The improvements proposed consist in the removal of snags and logs, the clearing away of overhanging trees on the banks, a small amount of dredging, and the construction of jetties or dikes, at first experimentally.

The total estimated cost of the work proposed was $55,755, which, however, was only for a part of the work that will be required for the entire portion of the river in need of improvement.

The act of March 3, 1881, appropriated $30,000 for the work with a proviso that $10,000 of this sum may be expended to extinguish before December 1, 1881, any claim of right that any company may have to collect tolls, &c.

Should the negotiations now pending be successful in extinguishing existing claims within the time specified, it is proposed to expend the amount which may be left in carrying out the above plan of improvement.

Amount appropriated by act approved March 3, 1881	$30,000 00
July 1, 1881, amount available	30,000 00
Amount (estimated) required for completion of existing project	35,755 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	35,800 00

(See Appendix I 14.)

15. *Lillington River, North Carolina.*—The act of June 14, 1880, directed an examination or survey of this river. An examination was accordingly made in August last, and a report with an estimate of cost transmitted to Congress.

The estimated cost of the whole improvement proposed amounted to $6,003.

The river and harbor act of March 3, 1881, appropriated $3,000 for this work.

It is proposed to apply this amount to clearing the river of logs and snags, cutting down and removing overhanging trees, and dredging off a few abrupt points, with a view to secure a 5-foot navigation from the mouth of the river, where it empties into the Cape Fear River, to the town of Lillington, some 11 miles above.

Amount appropriated by act approved March 3, 1881	$30,000 00
July 1, 1881, amount available	30,000 00
Amount (estimated) required for completion of existing project	3,003 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	3,000 00

(See Appendix I 15.)

16. *Town Creek, North Carolina.*—A survey of this creek, ordered in the act of June 14, 1880, was made in September last, and a report with estimate of cost of improvement proposed was transmitted to Congress.

The proposed improvement consists of removing all obstructions to a 4-foot navigation at ordinary low-tide from the mouth of the creek, where it empties into the Cape Fear River, to Saw Pit Landing, 20 miles above. The total estimated cost is $9,078.

The act approved March 3, 1881, appropriated $1,000 for this work, which amount it is proposed to expend in removing obstructions, as above indicated, so far as funds will permit.

Amount appropriated by act approved March 3, 1881	$1,000 00
July 1, 1881, amount available	1,000 00
Amount (estimated) required for completion of existing project	8,078 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	8,100 00

(See Appendix I 16.)

17. *Yadkin River, North Carolina.*—A survey of this river was made in 1878, and the results submitted to Congress.

It was proposed to improve the river for steamboat navigation from the railroad bridge, near Salisbury, to the foot of Bean Shoal, a distance of 64½ miles, by the construction of wing-dams and blasting and dredging through ledges of rock. The total estimated cost was $82,000.

The act of March 3, 1879, appropriated $20,000 for the work, but as there were a number of mill-dams on the river, with the owners of which no satisfactory arrangements could be made, no work was done.

The act of June 14, 1880, appropriated $20,000 additional for the improvement, of which $6,000 might be used to purchase dams. No final arrangements have yet been made with the owners, but it is believed satisfactory ones will be. The plant for working has been prepared, and a channel 50 to 60 feet wide cut up the river 1¾ miles above the railroad bridge, during June.

The act of March 3, 1881, appropriated $12,000 for continuing the operations. It is proposed to expend this amount in accordance with the original plan, viz, to provide a channel, 2½ to 3 feet in depth, through the numerous shoals and ledges of rock in the river.

July 1, 1880, amount available	$40,000 00	
Amount appropriated by act approved March 3, 1881	12,000 00	
		$52,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,275 61	
July 1, 1881, outstanding liabilities	4,105 28	
		8,380 89
July 1, 1881, amount available		43,619 11
Amount (estimated) required for completion of existing project		36,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		36,000 00

(See Appendix I 17.)

18. *Great Pee Dee River, South Carolina.*—During the past fiscal year operations have been conducted under the appropriation $7,000, made by act of June 14, 1880.

Work has been confined to the upper portion of the river, where the object in view is to obtain a navigable depth of 3½ feet at lowest stage of water.

The work done has been the removal of some 286 snags and logs from the bed of the river, and about 1 mile of the bank has been cleared of overhanging trees which were liable to fall in.

The act of March 3, 1881, appropriated $6,000 for the improvement of this river between "Little Bluff" and "Cheraw." The work on this portion is similar to that done the past year, and it is proposed to apply this appropriation to the clearing out of snags, logs, &c., and trimming the banks where needed, from "Little Bluff" as far up towards "Cheraw" as funds will permit.

July 1, 1880, amount available	$7,000 00	
Amount appropriated by act approved March 3, 1881	6,000 00	
		$13,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	5,688 39	
July 1, 1881, outstanding liabilities	527 04	
		6,215 43
July, 1881, amount available		6,784 57
Amount (estimated) required for completion of existing project		12,520 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		12,500 00

(See Appendix I 18.)

19. *Waccamaw River, North Carolina and South Carolina.*—The act of June 14, 1880, appropriated $15,000 for this improvement.

The object in view is to secure a channel 12 feet to the town of Conwayborough. It was originally proposed to dredge through obstructing bars, but as no bids were received for this work, and a dredge could not be had, except at an exorbitant price, the contraction of the waterway by dikes and jetties has been resorted to, and so far has proved successful, as in each case where it has been tried the channel has scoured out sufficiently to give the required depth; 854 linear feet of these jetties have been built.

The act approved March 3, 1881, appropriated $10,000 for this work. It is proposed to expend this amount partly to continuing the construction of jetties below Conwayborough and partly to clearing out the snags and logs above that point.

July 1, 1880, amount available	$15,000 00	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$25,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	3,369 29	
July 1, 1881, outstanding liabilities	2,585 51	
		5,954 80
July 1, 1881, amount available		19,045 20
Amount (estimated) required for completion of existing project		4,370 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		4,400 00

(See Appendix I 19.)

20. *Santee River, South Carolina.*—An examination of this river, directed in the river and harbor act of March 3, 1879, was made, and a report with the estimate of cost of proposed improvement transmitted to Congress.

It was proposed to clear the river of obstructions and secure a channel 7 feet deep at low-water, from the ocean to Wright's Bluff, a distance of about 154 miles, and a channel 5 feet deep over the remaining 30 miles of the river.

It was also proposed, as the bar at the mouth of the Santee would be difficult and expensive to improve, to deepen and straighten what is known as Mosquito Creek, by which vessels from the Santee would have an outlet through Winyah Bay to the ocean. The total estimated cost of this work is $104,427.

The act of Congress of March 3, 1881, appropriated $22,000 for improving Santee River, South Carolina, by deepening and straightening its outlet to Winyah Bay through Mosquito Creek. It is proposed to commence this work as soon as additional examinations can be made of the creek.

Amount appropriated by act approved March 3, 1881	$22,000 00
July 1, 1881, amount available	22,000 00
Amount (estimated) required for completion of existing project	82,427 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	55,000 00

(See Appendix I 20.)

21. *Wateree River, South Carolina.*—A survey of this river was directed by the river and harbor act of June 14, 1880, and a report with cost of proposed improvement was transmitted to Congress.

The estimated cost of the whole improvement amounted to about $54,000.

The act of March 3, 1881, appropriated $8,000 for this work.

It is proposed to apply this amount, according to approved project, to clear out obstructions in those portions most in need of improvement, and so ultimately secure a 4-foot navigation from the confluence of the Wateree and Congaree rivers to the town of Camden, 64 miles above.

Amount appropriated by act approved March 3, 1881	$8,000 00
July 1, 1881, amount available	8,000 00
Amount (estimated) required for completion of existing project	45,991 60
Amount that can be profitably expended in fiscal year ending June 30, 1883.	46,000 00

(See Appendix I 21.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with the requirements of the river and harbor act of June 14, 1880, Captain Phillips was charged with and completed the following, the results of which have been transmitted to Congress as indicated below:

1. *Georgetown Harbor, South Carolina.* (See Appendix I 22.)
2. *Lynch's River, South Carolina.* (See Appendix I 23.)
3. *Wateree River, from Camden, South Carolina, to its mouth.* (See Appendix I 21.) Printed as House Ex. Doc. No. 61, Forty-sixth Congress, third session.
4. *Black River, from Kingstree, South Carolina, to its mouth.* (See Appendix I 24.)
5. *Cape Fear River, North Carolina, between Wilmington and Fayetteville, with a view of ascertaining cost and practicability of clearing away logs and overhanging trees, and of dredging out such shoals as now interfere with commerce, itemizing cost of each separately.* (See Appendix I 14.)
6. *Town Creek, North Carolina, to ascertain cost of taking out such shoals as interfere with ordinary river steamboat traffic.* (See Appendix I 16.)
7. *Lillington River, North Carolina.* (See Appendix I 15.)
8. *Beaufort Harbor, North Carolina.* (See Appendix I 13.) Printed as House Ex. Doc. No. 78, Forty-sixth Congress, third session.
9. *Moccasin River (Contentnea Creek), North Carolina.* Printed as House Ex. Doc. No. 85, Forty-sixth Congress, third session. (See, also, Appendix I 12.)

And to comply with the provisions of the river and harbor act of March 3, 1881, Captain Mercur has been charged with and is now engaged upon the following, the results of which will be duly submitted when received:

1. *Oregon Inlet, North Carolina.*
2. *Whiteoak River, North Carolina.*
3. *Meherrin River, North Carolina.*
4. *New River, North Carolina.*
5. *Water line between the Cape Fear and Waccamaw rivers, North Carolina.*
6. *Bar at mouth of Winyah Bay, South Carolina.*

IMPROVEMENT OF THE RIVERS AND HARBORS ON THE COAST OF SOUTH CAROLINA, GEORGIA, AND THE ATLANTIC COAST OF FLORIDA.

Officer in charge, Lieut. Col. Q. A. Gillmore, Corps of Engineers, having under his immediate orders Capt. James C. Post, Corps of Engineers, until March 1, 1881, and Capt. B. D. Greene, Corps of Engineers, since March 1, 1881, and Lieut. W. L. Fisk, Corps of Engineers, since September 11, 1880.

1. *Charleston Harbor, South Carolina.*—The works of improvement now under construction consist of two jetties composed of riprap stone resting on mattresses of logs and brush, starting respectively from Sullivan's and Morris Islands, and converging towards each other so as to cross the bar on approximately parallel lines, with a gap of one-half to five-eighths of a mile between them, as shall be hereafter determined. The object of the improvement is to establish and permanently maintain a navigable channel across the bar not less than 21 feet at mean low-tide where heretofore the available low-water depth has not exceeded 11½ feet.

Previous to the adoption of the new project there had been expended in improving this harbor since the close of the civil war (from 1871 to 1878) the sum of $93,700 in taking up the wrecks of fourteen iron-clad and wooden vessels, and for other purposes.

During the fiscal year just closed there was laid on the seaward extension of the north jetty a length of 2,725 feet of apron foundation, varying in width from 113 to 118 feet, and in height from 2¾ to 3 feet, composed of a mattress of logs and brush about 1½ feet thick overlaid with riprap stone to the depth of about 1¼ feet. There was laid in the gap previously left on the Drunken Dick Shoal, thereby closing that gap, a length of 1,663 feet of apron foundation similar to the above in method of construction, 64 feet wide and 3¾ to 4 feet high. In addition to the foregoing, 7,407 cubic yards of riprap stone were distributed over the jetty south of Drunken Dick Shoal, raising the height in places to 13 and 14 feet.

There was laid on the south jetty a length of 4,363 feet of apron foundation across the main channel, and east and west of it, varying in width from 42 to 112 feet, and in height from 2¾ to 3 feet, composed of a mattress 1½ feet thick, overlaid with stone.

Some dredging was done in the channel to be improved, but, the bottom not yielding readily, this was kept up for a short time only.

At the end of the fiscal year the north jetty had reached a total length from Sullivan's Island of 12,042 feet, with widths varying from 43 feet at the shore to 118 feet at the outer end, and heights varying from 2¾ to 14 feet, and the south jetty had reached a total length of 6,912 feet, with widths varying from 40 feet at the shore to 112 feet at the sea end, and with heights varying from 2¾ to 3 feet.

In the report for the fiscal year just closed it is stated that—

> So far as appears, upon an examination by sounding, the foundations have stood well. The north jetty has perhaps settled a little in some places, as across the Beach Channel at one or two points, but not to a very considerable extent.

This settlement is doubtless the same as that mentioned in the last annual report, and there is no evidence that it has increased during the last fiscal year.

The jetties have not, as yet, produced any marked effect in deepening the channel selected for improvement, and it has not been expected that they would until a more advanced stage of progress has been reached.

The shores of Sullivan's and Morris islands are going away so rapidly as to furnish occasion for serious concern, and a remedy should be promptly applied. A couple of short spur jetties on Sullivan's Island and two or three on Morris Island would doubtless suffice to arrest this erosion, and their construction has been ordered.

It is proposed during the present fiscal year to confine the work mainly to the north jetty, extending it seaward, and raising it to higher levels, by methods substantially the same as those hitherto followed, and to dredge along those portions of the proposed channel where it may appear to be required. The south jetty will perhaps also be extended until it reaches shoaler water on the inner slope of the bar.

The estimated cost of this improvement as originally submitted March, 9, 1878 was	$1,800,000 00
There has been appropriated for it to date	745,000 00
Of this amount there has been expended up to June 30, 1880, including outstanding liabilities at that date, the sum of	252,216 41
There has been expended to June 30, 1881, including outstanding liabilities	465,659 55

July 1, 1880, amount available	$318,759 94	
Amount appropriated by act approved March 3, 1881	175,000 00	
		$493,759 94
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	108,765 45	
July 1, 1881, outstanding liabilities	105,654 04	
		214,419 49
July 1, 1881, amount available		279,340 45
Amount (estimated) required for completion of existing project		1,055,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		750,000 00

(See Appendix J 1.)

2. *Improvement of Sullivan's Island, for the protection of Charleston Harbor, South Carolina.*—By act approved June 14, 1880, the sum of $5,000 was appropriated for this work, the original intention being to expend it in the construction of two or three short spur jetties between Fort Moultrie and the new north jetty to protect the beach against further encroachment by the sea. It was finally decided to apply the remedy at the point most exposed, and build one jetty only. The point selected for the work is about 2,500 feet west of the north jetty.

This spur jetty was finished in December, 1880, its total length being 324 feet, of which a portion, 162 feet long, is formed of a double layer of logs, and the balance of a single layer. The bottom width is 30 feet, and the riprap stone put on the work amounted to 495 cubic yards.

The jetty is in good condition, and sand is accumulating in the vicinity.

A recent survey has shown that this shore requires still further protection.

The orignal estimate of the cost of this work was $6,000. Its cost was $5,000.

July 1, 1880, amount available	$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	5,000 00

(See Appendix J 2.)

3. *Ashley River, South Carolina.*—Ashley River is about 40 miles in length, and runs in a generally southeasterly direction. At its mouth the city of Charleston occupies its left bank.

By act approved June 14, 1880, the sum of $1,000 was appropriated for this improvement. Another appropriation of $1,500 was made by act approved March 3, 1881. These are the only appropriations ever made by Congress for improving this river.

A general description of the locality was given in the last annual report of the engineer in charge, contained in Appendix J 3, Annual Report of Chief of Engineers for 1880.

The work to be done consists in dredging through certain shoals located from 7 to 10 miles from the city of Charleston. No bids were received for doing the work under the first appropriation, and it was found impossible to hire a dredge for the purpose. Nothing, therefore, was done during the last fiscal year.

During the present fiscal year, it is proposed to expend the $2,500 now available, in dredging through certain shoals located about 2,000 feet below the Old Wando phosphate works, where low-water depth of only 7 feet was found by a recent survey, in order to connect the 11-foot low-water curves above and below. If no acceptable offer to do the work by contract is received an attempt will be made to hire a dredge for the purpose.

There are two other shoals lower down where the channel requires deepening. The cost of dredging at those places is estimated at $2,500.

This improvement when completed will directly aid the business of several phosphate works located above the shoals. Were there no manufactures there, the present depth would suffice.

July 1, 1880, amount available	$1,000 00	
Amount appropriated by act approved March 3, 1881	1,500 00	
		$2,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		20 07
July 1, 1881, amount available		2,479 93
Amount (estimated) required for completion of existing project		2,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		2,500 00

(See Appendix J 3.)

4. *Wappoo Cut, South Carolina.*—By the river and harbor act, approved March 3, 1881, the sum of $10,000 was appropriated for improving Wappoo Cut, S. C., this being the first appropriation ever made by Congress for the work.

Wappoo Cut is a narrow, tortuous, tidal creek to the north of James Island, S. C., connecting Stono and Ashley rivers.

The project of improvement recommended by the engineer in charge, in a report dated November 22, 1880, contemplated the establishment of a straighter channel of 6 feet by 90 feet, low-water dimensions, at an estimated cost of $34,000. At present only 2 to 4 feet can be carried over the principal shoals at mean low-tide.

The plan of improvement comprised dredging on the bar at the entrance into Ashley River, and at one place in the cut, a cut-off through the marsh about 2½ miles from Ashley River, closing three small tidal branches, and building a short jetty at both the Stono and Ashley river ends.

The engineer in charge recommends that it may be best to wait for another appropriation before beginning the work, for the reason that little could be actually accomplished with the amount now available, and the work done would be wanting in permanency of character. This matter is for the present held in abeyance.

Amount appropriated by act approved March 3, 1881	$10,000 00
July 1, 1881, amount available	10,000 00
Amount (estimated) required for completion of existing project	24,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	24,000 00

(See Appendix J 4.)

5. *Savannah River and Harbor, Georgia.*—During the last fiscal year the operations for the improvement of Savannah River and harbor were carried on in conformity to the general plan submitted by the engineer in charge August 28, 1873, and the supplementary project of March 19, 1879.

During the two years preceding the autumn of 1873, Congress had appropriated the sum of $100,000 for improving the river below the city of Savannah, which had been expended mainly in removing wrecks, cribs, and other obstructions.

No money had been appropriated before this since the close of the civil war.

By act approved February 27, 1874, Mr. Henry S. Welles was paid the sum $193,132.96 for expenditures made by him under contracts with the Treasury Department of May 1, and July 5, 1866, for removing obstructions from the Savannah River. This work comprised the removal of 20 vessels, 40 cribs, 150 piles, many iron-shod snags, and a number of torpedoes.

By the project of August 28, 1873, it was designed to provide for an improved channel from Tybee Roads to the city of Savannah, navigable at high-tide for vessels drawing 22 feet of water, where previously the navigable high-water depth rarely exceeded 15 to 16 feet.

The entire cost of the project, omitting bank projections and jetties or wing-dams, was estimated at $481,320.

Since its adoption there has been appropriated, to June 30, 1881, the sum of $482,000. The expenditures up to the close of the fiscal year ending June 30, 1880, including outstanding liabilities, were $249,472.13, and to June 30, 1881, $311,528.22.

The supplementary project of March 19, 1879, had for its principal object the improvement of the north channel of the Savannah River in preference to the south channel, from the head of Elba Island to the head of Long Island. This object was to be attained by closing the openings between the islands by means of dams and contracting the area of cross-section of the south channel, to secure a larger volume of flow in the north channel.

It was estimated that the construction of these various dams up to the level of ordinary low-water, the enlargement of the ship-channel by dredging to a minimum depth of 14½ feet and a width of 125 feet at mean low-tide on all the shoals between the city of Savannah and Tybee Roads, and the requisite deepening of the channel above the city to aid the flow of the ebb and flood currents, would add only a small amount to the estimate of August 28, 1873.

Since it has been decided to build the dams between the islands up to high-water level, the original estimate of $481,869.64 for works thus far approved, will probably be exceeded by from $25,000 to $30,000.

Summary of work done during the past fiscal year.—The submerged dam at the Cross Tides was completed in conformity to the original design by adding 245 cubic yards of stone to the superstructure, the shore end repaired, and the adjacent shore of Argyle Island protected from erosion.

The gap through the old King's Island jetty was enlarged to 70 feet. Work on the submerged dam across the south channel was continued for some time. When work shall be resumed under a new arrangement it is expected that the dam can be finished in 8 or 10 days.

Dredging has been executed at various places from the Cross Tides down to near Tybee Roads.

The total amount of material dredged was, according to assistant engineer S. L. Fremont's appended report, 268,220 cubic yards, of which 59,461 yards were taken out by the United States dredge steamer Henry Burden, and the balance by the American Dredging Company, of Philadelphia, under two contracts made with them, one on December 16, 1878, at the price of 14⅝ cents per yard, and the other on October 20, 1880, at 14 cents per yard. Only 5,136 cubic yards were taken out during the past year under the first-named contract, by which the same was terminated.

A draft of about 13 feet at low-water and 19 feet at high-water can now be carried from Tybee Roads to the city of Savanah.

Work contemplated during the present fiscal year.—It is proposed during the fiscal year ending June 30, 1882, to raise the crest of the dam at the Cross Tides to a higher level next to Argyle Island to enlarge the water-way at shoal places above the city, with a view of aiding the increased flow along the city wharves; to widen the gap in the old King's Island jetty; to widen and deepen the water-way in front of the city in accordance with the present project; to further improve the "Wrecks" channel below Fig Island by dredging, and perhaps by constructing a work to concentrate the currents through the channel and protect it from silt brought down Back River; to complete the submerged dam at the head of Elba Island in the south channel, as originally proposed; to build the three dams as designed between the islands from Elba to Cockspur, and to dredge at such points as may from time to time require it.

In addition to the foregoing, the necessary works for bank protection and channel contraction, to which reference has been made in previous reports, but for which no estimates of cost have until now been submitted, may be begun at two or three points where they will, beyond doubt, be required, no matter what plan for completing the improvements may be determined upon. Without taking into consideration at the present time the project contemplated in the act approved March 3, 1881, which requires an estimate to be submitted of the cost of improving the Savannah River and harbor so as to give a channel 22 feet deep from the bar to the city, with the same depth for a width of 600 feet in front of the city, it may be stated that the maintenance of the channel to be established under the project of August 28, 1873, will require an expenditure of $300,000 to $350,000 in the construction of spur jetties, training-walls, and bank revetments.

In the project and estimate called for by act approved March 3, 1881, which are expected to be ready before the 1st of December next, this subject of channel contraction will be discussed at greater length, and such of the works as require to be first undertaken will be definitely located and detailed estimates of their cost submitted. Additional works to be constructed later will depend for their character, magnitude, and location, in some degree upon the effects by closing dams between the islands below Fort Jackson. These dams will not be finished until some time next winter.

July 1, 1880, amount available	$157,527 87	
Amount appropriated by act approved March 3, 1881	65,000 00	
		$222,527 87
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	46,770 36	
July 1, 1881, outstanding liabilities	5,285 73	
		52,056 09
July 1, 1881, amount available		170,471 78
Amount (estimated) required for completion of existing project		350,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		350,000 00

(See Appendix J 5.)

6. *Savannah River, Georgia.*—The act approved March 3, 1881, appropriated the sum of $15,000 for this purpose, and it is presumed to be the intention of Congress that the money shall be expended on that portion of the river between the cities of Augusta and Savannah, inasmuch as the same act provides, in separate items, for improving Savannah River and Harbor and Savannah River above Augusta.

This is the first appropriation made by Congress for this object. For the greater part of the year boats drawing 4 to 5 feet can pass from Savannah to Augusta, a distance by river of 248 miles, but during the low-river season, the navigable depth, over some of the worst shoals, does not exceed 2 to 3 feet.

The principal obstructions are sand-bars, snags, and floating trees.

The plan of improvement recommended by the engineer in charge December 22, 1880, after an examination of the stream had been made contemplated narrowing the river by wing-dams where the widths are excessive; aiding the deposit of silt by light hurdle dikes; the revetment of caving banks; cutting away some projecting points; removing snags and piles, and dredging wherever necessary to aid the development of a low-water channel.

The object of the improvement is to secure a navigable low-river channel 5 feet deep, and its estimated cost is $91,000. It is proposed to do the work by hired labor, and steps have been taken to procure a snag-boat.

During the present fiscal year some of the most serious snag obstructions will be removed, and perhaps the construction of wing-dams near Augusta will be commenced.

Amount appropriated by act approved March 3, 1881	$15,000 00
July 1, 1881, amount available	15,000 00
Amount (estimated) required for completion of existing project	76,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	76,000 00

(See Appendix J 6.)

7. *Savannah River above Augusta, Georgia.*—By act approved March 3, 1881, the sum of $8,000 was appropriated for this improvement, and the sum of $16,000 was previously appropriated by act of June 14, 1880.

No expenditures were made prior to June 30, 1880. Work during the fiscal year just closed did not begin until June, in consequence, mainly, of a prolonged high-river stage. The operations consisted in the removal by contract of 163 cubic yards of rock from the river bottom and from an old dam, the removal of a few yards of gravel, and the construction of 658 cubic yards of stone dam; and it is reported that immediate and permanent benefits have already been secured for the pole-boat navigation. The points improved are within 1½ miles of the upper end of Augusta canal, and within 8 miles of the city of Augusta. The project contemplated the establishment of a pole-boat channel 3 feet deep and 20 feet wide at an estimated cost of $45,000.

During the present fiscal year the work will consist in removing gravel and rock from the bed of the stream, and in contracting the water-way in some places by wing-dams. Under the existing appropriations no work is contemplated above Trotter's Shoals, 64 miles from Augusta.

More recent information leads the officer in charge to doubt the practicability of this improvement, and the propriety of making the appropriation of $21,000 asked for in the estimate submitted.

July 1, 1880, amount available	$16,000 00	
Amount appropriated by act approved March 3, 1881	8,000 00	
		$24,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	569 73	
July 1, 1881, outstanding liabilities	2,314 29	
		2,884 02
July 1, 1881, amount available		21,115 98
Amount (estimated) required for completion of existing project		21,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		21,000 00

(See Appendix J 7.)

Saint Augustin's Creek (*Thunderbolt River*), *Georgia.*—By the river and harbor act approved March 3, 1879, the sum of $5,000 was appropriated for improving Saint Augustin's Creek, Ga., constituting a part of the inside passage between the Savannah River and Jacksonville, Fla. This is the first appropriation ever made by Congress for this river.

The improvement required consisted in the entire or partial removal of the wreck of a large timber dry-dock, sunk during the late civil war, situated near the middle of the stream about a mile from its confluence with the Savannah River. The wreck was removed to a depth of 10 feet below mean low-water.

There appears to be no necessity at present for any further improvement of the river at this point, and no other appropriation is asked.

July 1, 1880, amount available	$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,582 34
July 1, 1881, amount available	3,417 66

(See Appendix J 8.)

Altamaha River, *Georgia.*—By act approved March 3, 1881, the sum of $5,000 was appropriated for improving Altamaha River, this being the first appropriation ever made by Congress for this object.

The Altamaha is the most important river lying entirely within the State of Georgia, and is formed by the confluence of the Oconee and Ocmulgee. It is 155 miles long, has a southeasterly course, and empties into the Atlantic Ocean through Altamaha Sound, below the town of Darien.

It was examined under the provision of section 2 of the act approved June 14, 1880, and the report thereon with a project of improvement was submitted by the engineer in charge under date November 27, 1880.

The chief obstructions to navigation consist in rock ledges, sand-bars, and snags, and the plan of improvement provides for their removal so as to secure a navigable low river channel 80 feet wide and 3 feet deep, at an estimated cost of about $60,000.

It is proposed during the present fiscal year to expend the sum of $5,000, lately appropriated, in removing snags of the worst character, and perhaps some rock bars, or reefs, so as to give a passage of about 80 feet width for light-draught steamboats. The snag-boat, which is now being fitted up for employment on the middle Savannah River, will also be used on this improvement, and a part of her cost will be charged to the Altamaha River appropriation.

The work on the Altamaha cannot well be done by contract.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount available	5,000 00
Amount (estimated) required for completion of existing project	55,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	55,000 00

(See Appendix J 9.)

10. *Brunswick Harbor*, *Georgia.*—During the last fiscal year operations have been carried on in general conformity to the plan suggested by the engineer in charge in his report of April 29, 1876. That plan comprises the construction of a low crib jetty, starting from the northeasterly point of Buzzard's Island, and located approximately parallel to and 1,000 feet distant from the opposite shore, for the purpose of contracting the water-way and concentrating the currents upon a shoal about 1 mile below the city of Brunswick. The bottom being hard and tough in places, dredging has been necessary. The object of these works is to establish and maintain a channel at least 15 feet deep at mean low-tide, where heretofore there existed a navigable low-water depth of only 9 feet.

The amount expended up to June 30, 1880, was $1,591.46.

The actual work of sinking the palmetto cribs resting on a pine grillage or platform did not begin until October, 1880. The total number of cribs sunk up to June 30, 1881, is 37, of which 14 constitute the return face at right angles to the shore, about 300 feet in length, exclusive of the portion, 35 feet long, above low-water line. The 23 cribs on the main line cover a length of 475 feet. All the cribs are kept some feet below the water-level, the filling being topped off with broken stone at a slope of about 1 on 2 on each side.

During the year 34,160 cubic yards of material was removed by dredging, resulting, with previous dredging, in a cut through the shoal varying in depth from 12 to 15 feet and in width from 20 to 80 feet (one cut to four cuts), and extending in a straight line from the 12½-foot curve on the inside slope of the shoal to a depth of 14 feet on the outside. The length of the cut is about 4,400 feet.

During the present fiscal year it is proposed to continue work on the jetty, extending it to a point beyond the crest of the shoal, and to widen and deepen the channel by dredging. The use of cribs will not be continued much further. The extension will be made with a low double-raft jetty, composed of two layers or platforms of round logs loaded with riprap stone.

Estimated cost of the improvement		$73,187 50
Amount appropriated to June 30, 1881		35,000 00
July 1, 1880, amount available	$28,408 54	
Amount appropriated by act approved March 3, 1881	5,000 00	
		33,408 54
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	9,715 14	
July 1, 1881, outstanding liabilities	3,453 16	
		13,168 30
July 1, 1881, amount available		20,240 24
Amount (estimated) required for completion of existing project		38,187 50
Amount that can be profitably expended in fiscal year ending June 30, 1883.		38,200 00

(See Appendix J 10.)

11. *Entrance to Cumberland Sound, Georgia and Florida.*—By act approved June 14, 1880, the sum of $30,000 was appropriated for improving the entrance to Cumberland Sound between Amelia and Cumberland Islands, which was the first provision made by Congress for improving this entrance. No expenditures were made prior to June 30, 1880.

By act approved March 3, 1881, an additional sum of $100,000 was appropriated for the same object. The plan of improvement, quite recently begun, is described in general terms in a report of the engineer officer in charge, dated June 30, 1879, contained in Appendix I 8, Annual Report of the Chief of Engineers for 1879.

The project consists essentially of two low jetties, composed of riprap stone, resting on a broad foundation mattress of logs, or logs and brush, starting respectively from the opposite shores of the entrance, and extending seaward across the bar upon lines so directed that the outer ends will be approximately parallel to each other, and from 3,000 to 3,500 feet apart, or such distance as may hereafter be adopted. The estimated cost of the improvement, with two long jetties, is $2,071,023. They are calculated to maintain a low-water depth across the bar of not less than 20 to 21 feet, or a high-water depth of 26 to 27 feet. If only one long jetty is built on the north side, with a spur jetty on the south side, the cost will not exceed about $1,000,000, and the low-water depth maintained will not, perhaps, exceed 16 to 17 feet. Heretofore the depth on the bar channel has not usually exceeded 13 to 13½ feet at mean low-water, and at times has been as low as 11½ feet

During the fiscal year just closed, the north jetty was begun, after great delay on the part of the contractor. This jetty starts from the sea shore of Cumberland Island at a point about 2,000 feet distant from its southern extremity, and is directed in a range bearing south 63½ degrees east.

Up to June 30, 1881, the length of apron foundation put down amounted to only 276 feet, with widths varying from 25 to 35 feet. It is composed of a log and brush mattress about 19 inches thick, overlaid with riprap stone to the depth of about 1¼ feet in the work.

During the current fiscal year it is proposed to expend the balance of the two appropriations in extending the north jetty, and perhaps in starting the south jetty, by methods substantially the same as that now in use. Estimated cost of the work of improvement, $2,071,023.

July 1, 1880, amount available	$30,000 00	
Amount appropriated by act approved March 3, 1881	100,000 00	
		$130,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		1,077 02
July 1, 1881, amount available		128,922 98
Amount (estimated) requiredfor completion of existing project		1,941,023 00
Amount that can be profitably expended in fiscal year ending June 30, 1838		500,000 00

(See Appendix J 11.)

12. *Inside passage between Fernandina and Saint John's River, Florida.*—By act approved June 14, 1880, the sum of $7,000 was appropriated for continuing the improvement of this passage.

Appropriations for its improvement were made at various times from 1828 to 1838, aggregating $78,000, chiefly expended in dredging out Kingsley's Cut, in Amelia River, 3 or 4 miles south of Fernandina, and Gunnison's Cut, in Sawpit Creek, 4½ miles south of Nassau Sound.

No further appropriations were made until the year 1874.

The sums appropriated in 1874 ($10,000) and 1879 ($7,000) were expended mostly in dredging on the worst shoals between Nassau Sound and Saint John's River, more especially at the junction of Sister's Creek with Saint John's River, at Cow Bank, Ocmulgee Point, Deepwater Point, and Gunnison's Cut, the object being to secure low-water depth of 4 to 5 feet.

During the last fiscal year the work consisted entirely of dredging, and was confined to Gunnison's Cut, which had shoaled about 2 feet, low-water depth. When work was suspended in December, a single cut had been made for a length of about 2,057 feet, giving a low-water depth of 5 feet.

The work has not since been resumed, for the reason given by the engineer in charge, that there seemed to be not only no urgent need for its continuance, but no prospect of securing any permanent improvement from the expenditure of small appropriations.

The recently shortened railroad lines from Fernandina to Jacksonville and from Fernandina to Savannah will undoubtedly lessen the value of this inland water route.

July 1, 1880, amount available	$7,007 62
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,570 11
July 1, 1881, amount available	4,437 51

(See Appendix J 12.)

13. *Saint John's River, Florida.*—During the last fiscal year work was begun upon the project for improving the channel over the bar at the mouth of the Saint John's River by means of two jetties, as described in a report of the engineer officer in charge, printed in Appendix I 7, Annual Report of the Chief of Engineers for 1879. The object of the improvement is to maintain a channel for large ocean-going vessels, where heretofore the low-water depths have not exceeded 6 to 8 feet. No expenditures had been made under this project up to June 30, 1880.

The work done during the year was confined to the south jetty, and consisted in laying 2,786 linear feet of apron foundation, composed of a log and brush mattress about 19 inches thick, overlaid with stone to the depth in the work of about 1¼ feet. Of this total length, a section 874 feet long, varying in width from 20 to 36 feet, and in height from 2½ to 3 feet, constituted the shore end, starting from high-water line and laid on a straight range bearing north 46¾ degrees east. Another section amounting to a length of 1,916 feet was laid on the main line, in a direction bearing north 74 degrees and 54 minutes east. It is composed of a mattress like that above mentioned, varying in width from 38 to 87 feet, overlaid with stone to the depth of 12 to 15 inches; the thickness of mattresses and stone varying from 2¾ to 3 feet. The work remains in good condition.

During the present fiscal year it is proposed to extend the south jetty seaward toward the crest of the bar, to raise it higher where it crosses deep water, and to begin the north jetty, the work on both jetties to consist mainly, as heretofore, in mattress work overlaid with stone.

Estimated cost of the improvement		$1,306,409 00
Amount appropriated to June 30, 1881		225,000 00
Amount expended to June 30, 1881, including outstanding liabilities		42,296 92
July 1, 1880, amount available	$125,000 00	
Amount appropriated by act approved March 3, 1881	100,000 00	
		$225,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	28,521 42	
July 1, 1881, outstanding liabilities	13,775 50	
		42,296 92
July 1, 1881, amount available		182,703 08
Amount (estimated) required for completion of existing project		1,201,409 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		500,000 00

(See Appendix J 13.)

14. *Improvement of Volusia Bar, Florida.*—By act approved June 14, 1880, the sum of $5,000 was appropriated for improving Volusia Bar, Fla. The act also authorized the Secretary of War "to make such special contract for the prosecution of the work as may in his judgment best promote the interests of the government." This was the first appropriation made for the work.

A second appropriation of $5,500 was made by act approved March 3, 1881.

Volusia Bar is located at the southeast end of Lake George, about 162 miles from the mouth of the Saint John's River at a point where the waters of the river discharge into the lake.

A project of improvement by means of two brush and stone jetties, with a view of establishing and maintaining a channel 6 feet deep over this bar, where heretofore the low-river depth has occasionally not exceeded 4 to 4½ feet, was submitted by the engineer in charge July 16, 1879. The estimated cost of the work was $15,000.

During the last fiscal year work was confined to the west jetty, of which there was laid by contract a length of 1,950 feet varying in width from 6 feet near the shore to 12 feet at the outer end and in height from 2 to 2½ feet.

Fender piles were driven to keep boats away from the work. The free end rests in 3½ feet of water. During the present fiscal year it is the intention to extend the west jetty beyond the crest of the bar into 6 feet water, and to begin the east jetty, by methods substantially the same as those hitherto followed.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	5,500 00	$10,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,977 60	
July 1, 1881, outstanding liabilities	22 40	5,000 00
July 1, 1881, amount available		5,500 00
Amount (estimated) required for completion of existing project		5,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		5,000 00

(See Appendix J 14.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with the provisions of the river and harbor act of June 14, 1880, Lieutenant-Colonel Gillmore was charged with the following examinations and surveys and has completed them all except one, which is now in progress:

1. *Edisto and Salkiehatchie rivers, in South Carolina.* Printed in House Ex. Doc. No. 23, Forty-sixth Congress, third session. (See also Appendixes J 15 and J 16.)
2. *For the reopening of the Santee Canal.* Printed as Senate Ex. Doc. No. 60, Forty-sixth Congress, third session. (See also Appendix J 17.)
3. *For the improvement of Wappoo Cut, South Carolina.* Printed in House Ex. Doc. No. 19, Forty-sixth Congress, third session. (See also Appendix J 4.)
4. *The Altamaha River, Georgia.* Printed in House Ex. Doc. No. 19, Forty-sixth Congress, third session. (See also Appendix J 9.)
5. *The Canoochee River, Georgia.* Printed in House Ex. Doc. No. 19, Forty-sixth Congress, third session. (See also Appendix J 18.)
6. *Romney Marsh, near Doboy, and the mouth of Jekyl Creek.* Printed in House Ex. Doc No. 19, Forty-sixth Congress, third session. (See also Appendixes J 19 and J 20.)
7. *For the opening of a ship-canal across the Charleston Neck, South Carolina.* Printed in House Ex. Doc. No. 19, Forty-sixth Congress, third session. (See also Appendix J 21.)
8. *For the opening of steamboat communication from the Saint John's River, Florida, by way of Topokalija Lake, to Charlotte Harbor or Pease Creek.*—This examination was not completed at the close of the fiscal year. Surveying parties took the field in January. A considerable number of lines have been run with the transit and level and compass and level between the designated terminal points of the route, and the location and surface altitudes of all the important lakes on or near the trial lines were determined. Reconnaissances were made in various directions in the vicinity of Kissimee River, the Upper Saint John's Lake, Okeechobee, and Charlotte Harbor.

It is not probable that all the field work will be completed before the rainy season sets in in July and compels a withdrawal of the party. It is expected that the examination will be finished and a report thereon submitted during the coming winter.

9. *The Savannah River, from Savannah to Augusta, Georgia.* Printed in House Ex. Doc. No. 23, Forty-Sixth Congress, third session. (See also Appendix J 6.)

And in compliance with the river and harbor act of March 3, 1881, the same officer has been charged with, and is now engaged upon the following, the result of which will be duly submitted, when received:

1. *Survey and estimates of the cost of the further improvements necessary to be made in the Savannah River and Harbor to increase the depth of the water in said river and harbor from the bar up to the city to 22 feet, and an estimate of the cost of widening the channel of the Savannah River opposite the city to 600 feet of uniform depth with the balance of the channel.*

2 *Examination of Indian River, Florida, at the north end, in view of opening a passage into the lagoon one-half mile east.*

GULF OF MEXICO.

IMPROVEMENT OF THE HARBORS OF MOBILE, ALABAMA, AND OF PENSACOLA AND CEDAR KEYS, FLORIDA; OF TAMPA AND APALACHICOLA BAYS, FLORIDA; AND OF CERTAIN RIVERS IN GEORGIA, ALABAMA, FLORIDA, AND MISSISSIPPI, EMPTYING INTO THE GULF OF MEXICO.

Officer in charge, Capt. A. N. Damrell, Corps of Engineers.

1. *Mobile Harbor, Alabama.*—The present project for the improvement of this harbor was adopted in March, 1880, the object being to afford a channel of entrance, from the Gulf of Mexico to the city of Mobile of 200 feet width and of not less than 17 feet depth. The present channel is 200 feet wide through "Dog River Bar," and 300 feet through "Choctaw Pass Bar," with not more than 13 feet depth at the shoalest part, and was obtained by dredging under previous appropriations, between 1870 and 1878, amounting in the aggregate to $401,000.

The amount expended to June 30, 1881, is $22,638.79, and has resulted in securing a channel 35 feet wide and minimum depth of 17 feet, at mean low-tide, 3½ miles long, and the widening of the cut to 70 feet for a distance of 0.57 of a mile, with the same depth.

The amount available and the appropriation asked for, $200,000, is to be expended in extending and widening the above cut, and it is expected that a channel-way will be obtained through to the city, of a minimum depth of 17 feet, and sufficiently wide to be used, thereby giving great relief to the commerce of the port.

Under the appropriation of $100,000, made by act of Congress, approved March 3, 1879, the lowest bid received was 24.9 cents per cubic yard, which was rejected; under that combined with the appropriation of June 14, 1880, a total of $225,000, the lowest bid was 12.3 cents per cubic yard, or less than one-half.

July 1, 1881, amount available	$224,884 00	
Amount appropriated by act approved March 3, 1881	100,000 00	
		$324,884 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	21,575 72	
July 1, 1881, outstanding liabilities	947 07	
		22,522 79
July 1, 1881, amount available		302,361 21
Amount (estimated) required for completion of existing project		495,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		200,000 00

(See Appendix K 1.)

2. *Pensacola Harbor, Florida.*—The present project for the improvement of this harbor was adopted in 1881, the object being to open a channel by dredging through a shoal which has formed inside the outer bar, 300 feet wide and 24 feet deep at mean low-water, and to construct such jetties as may be necessary to prevent the further abrasion of the beach near Fort McRae, or on the western side of the entrance to the harbor, and to maintain the dredged channel. The natural channel has a depth of not more than 20 feet at the shoalest part at mean low-water.

The amount expended to 30th of June, 1881, is $3,486.60 which has been used in surveys for locating channel and jetties, advertising for bids, office expenses, and preliminary work generally.

The amount available, and the appropriation of $75,000, asked for is to be applied to the construction of jetties and the dredging of a channel according to the above project.

July 1, 1880, amount available	$53,098 07	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$73,098 07
July 1, 1881, amount expended during the fiscal year, exclusive of outstanding liabilities July 1, 1880		3,486 60
July 1, 1881, amount available		69,611 47
Amount (estimated) required for completion of existing project		104,470 25
Amount that can be profitably expended in fiscal year ending June 30, 1883		75,000 00

(See Appendix K 2.)

3. *Harbor at Cedar Keys, Florida.*—The project adopted for this improvement was to open a channel 200 feet wide, and of as great a depth as the underlying limestone would permit, not exceeding 12 feet, from the Gulf of Mexico to Cedar Keys. To accomplish this a cut 200 feet wide had to be made through the outer bar, on which there was only an average depth of 8½ feet of water, a cut through the middle ground of same width, where there was only a depth of 1¾ feet of water at mean low-tide, the removal of some shoals in the channel between the outer bar and middle ground, and the removal of the wreck of the Steamer Lewisburg near the west end of the railroad wharf.

The amount expended in accomplishing this improvement is $82,500, or $51,000 less than the original estimate, which is due to the modifications made from the original plan as well as to the reduced prices paid for dredging during the last two years.

The increase in commerce from the westward, which may result from the improvement of the Suwanee River, may require the opening of the northwest channel to this harbor. A survey will be necessary to ascertain the cost of such improvement, before any appropriation is asked for.

July 1, 1880, amount available	$26,649 43
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	26,447 46
July 1, 1881, amount available	201 97

(See Appendix K 3.)

4. *Chattahoochee River, Georgia and Alabama.*—The present project for the improvement of this river was adopted in 1873, the object being to afford a channel 100 feet wide and 4 feet deep at low-water from Chattahoochee, its mouth, to Columbus, Ga. The original channel was impassable, at times, between Columbus and Eufaula, and the least depth on the bars varied from 1 to 3 feet. It was at other places narrow and much obstructed with snags.

The amount expended to June 30, 1881, is $86,040.64 (estimated, as no separate account was kept of the expenditure on the Chattahoochee and Flint when the appropriation was made for both together), and has resulted in opening and keeping open to navigation the whole year the whole length of the river.

Complaints have been made as to the effect of some of the constructions, which will be investigated.

The amount available and the appropriation asked for, $65,000, is to be applied to continuing the improvement according to the approved project.

July 1, 1880, amount available	$37,204 66	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$57,204 66
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		18,245 30
July 1, 1881, amount available		38,959 36
Amount (estimated) required for completion of existing project		115,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		65,000 00

(See Appendix K 4.)

5. *Flint River, Georgia.*—The present project for the improvement of this river was adopted in 1873, and modified in 1880, the object of the original project being to afford a channel 100 feet wide and 3 feet deep from the mouth up to Albany, Ga., and of the modification to improve for high-water navigation that portion of the river between Albany and Montezuma, about 77 miles above.

The old channel was formerly only navigable to Bainbridge at low-water, and for that distance was narrow, crooked, and dangerous.

The amount expended to June 30, 1881, is $48,025.16, and has resulted in opening a channel of the proposed depth and width from the mouth of the river to "Hell Gate," a distance of 58 miles, and in clearing the channel between Albany and Montezuma, for a distance 10 miles above Drayton, for high-water navigation.

The appropriation of $75,000 asked for the year ending June 30, 1883, is to be applied to continuing the improvement on the lower river towards Albany and on the upper river towards Montezuma.

Amount available	$22,867 52	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$37,867 52
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		15,892 68
July 1, 1881, amount available		21,974 84
Amount (estimated) required for completion of existing project		152,829 52
Amount that can be profitably expended in fiscal year ending June 30, 1883		75,000 00

(See Appendix K 5.)

6. *Apalachicola River, Florida.*—The project for the improvement of this river was adopted in 1874, the object being to afford a channel of 6 feet depth and sufficient width its whole length, avoiding the worst portion by utilizing Styx River and Mocassin Slough.

The natural channel had sufficient depth and generally sufficient width, but was considerably obstructed by snags, and the portion through Mocassin Slough was crooked, narrow, and difficult. The amount expended to June 30, 1881, is $32,260.42, and has resulted in opening the river and keeping it open as projected, and in addition greatly improving the navigation of Chipola Cut-off a distance of 9 miles (from its upper end to White's Bluff), giving access by steamer to the orange groves along Dead Lake.

The amount available and the appropriation asked for is to be applied to preserve the improvement already made, and to close or partially close some of the outlets of this river, as auxiliary to the improvement of the bar at its mouth.

July 1, 1880, amount available	$5,905 39	
Amount appropriated by act approved March 3, 1881	1,500 00	
		$7,405 39
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		3,165 81
July 1, 1881, amount available		4,239 58
Amount (estimated) required for completion of existing project		43,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		25,000 00

(See Appendix K 6.)

7. *Apalachicola Bay, Florida.*—The present project for the improvement of this harbor was adopted in 1880, the object being to afford a channel of entrance from Apalachicola Bay to the river of the same name 100 feet wide and 11 feet deep at mean low-water. The present channel has a depth of about 3½ feet at the shoalest place.

The amount expended to June 30, 1881, is $401.11, and was for advertising and preliminary work. A contract has been executed in connection with the work, but the contractor not being ready no work was accomplished during the year.

With the amount available, $19,598.89, and the appropriation, $80,000, asked for, it is proposed to dredge the channel referred to above, and it is expected the amount will complete the project.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$20,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		401 11
July 1, 1881, amount available		19,598 89
Amount (estimated) required for completion of existing project		80,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		80,000 00

(See Appendix K 7.)

8. *Tampa Bay, Florida.*—The present project for the improvement of the harbor was adopted in 1880, the object being to afford a channel 150 feet wide and 9½ feet deep from Ballast Point to the mouth of the Hillsborough River, and of the same depth and 200 feet wide up to the town of Tampa. The present channel has not more than 5 feet depth in the shoalest place.

The amount expended to June 30, 1881, is $9,885.61, and has resulted in making a cut of the projected depth and 60 feet wide, 2,900 in length.

The amount available and the appropriation of $77,000 asked for is to be expended in widening and extending the above cut by dredging, and may, possibly, complete the project.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$20,000 00
July 1, 1881, amount expended during the fiscal year, exclusive of outstanding liabilities July 1, 1880		9,885 61
July 1, 1881, amount available		10,114 39

Amount (estimated) required for completion of existing project	$77,002 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	77,000 00

(See Appendix K 8.)

9. *Suwanee River, Florida.*—The present project for the improvement was adopted in August, 1880, the object being to afford a channel of entrance from Suwanee Bay, through both the east and west passes into the Suwanee River, of navigable width, and of not less than 5 feet depth at mean low-water, and to improve the river above, so as to give a least depth of 4 feet from Roland's Bluff to Ellaville, with a width of 50 feet.

The present channel across the bar has not more than 3.8 feet depth at its shoalest place; from there to Roland's Bluff there is a least depth of 5 feet, and from Roland's Bluff to Ellaville the depth varies from 17 feet to 1½ feet at mean low-water, snags and overhanging trees obstructing the river.

The amount of $314.26 was expended during the year ending June 30, 1881, defraying advertising and office expenses.

The appropriation of $25,000 asked for is to be applied to continuation of the improvement under the adopted project.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$8,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		314 26
July 1, 1881, amount available		7,685 74
Amount (estimated) required for completion of existing project		47,158 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		25,000 00

(See Appendix K 9.)

10. *Choctawhatchee River, Florida.*—The present project for the improvement of this river from its mouth to Geneva was adopted in 1872, the object being to improve the navigation of the river, by the removal of snags, overhanging trees, wrecks, and other obstructions, to accommodate the trade at that time.

The present project for the improvement of this river from Geneva to Newton was adopted in 1880, its object being to improve this section of the river for high-water navigation by the removal of snags, sunken logs, and overhanging trees.

The amount expended to June 30, 1881, is $27,367.38, and has resulted in making navigation as far up as Geneva comparatively safe, 140 miles on this section of the river having been improved. No work was done between Geneva and Newton.

The appropriation of $25,000 asked for is to be applied to clearing the river of all snags, stumps, and overhanging trees, from the mouth to Geneva, and to the removal of the remainder of the wreck of a steamer, and to obtaining a high-water channel from Geneva towards Newton, as far as the appropriation will permit.

July 1, 1880, amount available	$8,047 53	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$18,047 53
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		8,414 86
July 1, 1881, amount available		9,632 67
Amount (estimated) required for completion of existing project		86,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		25,000 00

(See Appendix K 10.)

11. *Withlacoochee River, Florida.*—The project for this improvement, adopted in 1881, is to improve the river by the removal of snags, overhanging trees, loose rocks, the deepening of some of the worst shoals, and a bar near the mouth of the river, so as to enable boats drawing 2 feet of water to navigate the river during about half of the year. The present depth of the river varies from 1 foot to 7½ feet, with a width of from 50 to 160 feet.

No expenditure has been made during the fiscal year ending June 30, 1881.

The appropriation of $16,400, asked for fiscal year ending June 30, 1883, is to be applied to the completion of the project for the improvement of this river, which will not be permanent; the amount required to preserve the work cannot be estimated, but will be small.

Amount appropriated by act approved March 3, 1881	$7,500 00
July 1, 1881, amount available	7,500 00
Amount (estimated) required for completion of existing project	16,400 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	16,400 00

(See Appendix K 11.)

12. *Pease Creek, Florida.*—The project for this improvement, adopted in 1881, is to improve this stream for high-water navigation by the removal of snags, sunken logs, overhanging trees, and loose rocks from the channel, from its mouth to Fort Meade.

The present depth varies from 6 inches to 8 feet, with a width of from 50 to 150 feet.

No expenditure has been made during the fiscal year ending June 30, 1881.

The appropriation of $9,700, asked for fiscal year ending June 30, 1883, is to be applied to the completion of the project for the improvement of this work, which will not be permanent; the amount required to preserve the work cannot be estimated, but will be small.

Amount appropriated by act approved March 3, 1881	$7,000 00
July 1, 1881, amount available	7,000 00
Amount (estimated) required for completion of existing project	9,700 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	9,700 00

(See Appendix K 12.)

13. *Escambia River, Alabama and Florida.*—The present project for the improvement was adopted in 1880. The object is to afford a channel of entrance from Escambia Bay into Escambia River of 150 feet width and 5½ feet deep at mean low-water, and to improve the river above to the Alabama and Florida State line.

The least depth at present on the bars in the natural channel is 1.9 feet. The river has sufficient depth and width, but is obstructed by snags and log booms; needs rectification at places, and the banks require protection at points to prevent wash.

No work was done on this improvement up to June 30, 1881; the amount of $328.69 was expended for advertising and office expenses.

The appropriation of $12,000 asked for can be profitably expended during the year ending June 30, 1883, and it is proposed to apply the same to the completion of the project adopted.

This improvement will not be permanent in its character, but will require a comparatively small expenditure every two or three years for its preservation.

July 1, 1880, amount available	$8,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$13,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		328 69
July 1, 1881, amount available		12,671 31
Amount (estimated) required for completion of existing project		12,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		12,000 00

(See Appendix K 13.)

14. *Alabama River, Alabama.*—The project for the improvement of this river was adopted in 1876, the object being to afford a channel 200 feet wide and 4 feet deep at low-water, from its mouth, 50 miles above Mobile, Ala., to Wetumpka, Ala.

Work was commenced on this improvement in the summer of 1878 and has been continued, during low-water seasons, up to the present time. During the fiscal year ending June 30, 1881, $18,688.04 were expended, and with this amount five shoals at Gardner's Island, Cox's Bar, Hadnot's Bar, Three Chutes, and bar below Cut-Off were improved so as to afford a sufficient depth of water. The dam at the Cut-Off and several of the works previously constructed were repaired, and the most dangerous snags were removed, as far as Montgomery.

By act of March 3, 1881, the sum of $20,000 was appropriated for this work, making the total amount available July 1, 1881, $41,854.20, to be applied to the continuance of the improvement from Gardner's Island, 320 miles above Mobile towards Wetumpka, as far as the funds will permit, by continuing the construction of dams and jetties to deepen shoals, removal of snags, and necessary construction of shore protections.

July 1, 1880, amount available	$40,542 24	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$60,542 24
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		18,688 04
July 1, 1881, amount available		41,854 20
Amount (estimated) required for completion of existing project		129,741 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		50,000 00

(See Appendix K 14.)

15. *Warrior and Tombigbee rivers, Alabama.*—The present project for the improvement of these rivers was adopted in 1875, the object being to afford a channel 80 feet wide and 3 and 4 feet deep at low-water from the mouth of the Tombigbee up to Columbus, Miss., and up the Warrior to Tuscaloosa, Ala.

The natural channel was not navigable at low-water.

The amount expended to June 30, 1881, is $109,290.74 on the Warrior above Tuscaloosa and on the Tombigbee below Columbus—the appropriations having been made jointly—and has resulted in obtaining a channel about 50 feet wide and 3 feet deep, with the exception of two bars, where the work already constructed needs repairs and revision.

With a proportionate amount of the appropriation of $70,000 asked for fiscal year ending June 30, 1883, it is proposed to continue the improvement by widening and deepening the channel according to the project, as far up as the funds available will permit, and in keeping the channel free of snags and other obstructions.

July 1, 1880, amount available	$54,786 96	
Amount appropriated by act approved March 3, 1881	25,000 00	
		$79,786 96
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		29,077 70
July 1, 1881, amount available		50,709 26
Amount (estimated) required for completion of existing project		178,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		70,000 00

a. Tombigbee below Vienna, Alabama.—The present project for the improvement of this section of the river was adopted in 1871, and modified in 1879, the object being to afford a low-water channel of navigable width and 4 feet depth from its mouth to Demopolis, and 3 feet depth from Demopolis up to Vienna. The old channel was navigable at low-water only as far as Demopolis, and navigation was difficult and dangerous at all times.

With a proportionate amount of the appropriation of $70,000 asked for, for fiscal year ending June 30, 1883, it is proposed to complete the improvement below Demopolis and extend the same up the river from that point as far as funds available with permit.

b. Tombigbee below Columbus, Mississippi, and Vienna, Alabama.—The present project for the improvement of the river was adopted in 1871, and modified in 1879, the object being to afford a low-water channel of navigable width with a depth of 3 feet from Vienna to Columbus, Miss. The old channel was not navigable at all at low-water.

With a proportionate amount of the appropriation of $70,000 asked for year ending June 30, 1883, it is proposed to keep the channel free of snags and other obstructions, and to improve as many shoals to the required depth of 3 feet from Vienna up as the funds available will permit.

(See Appendix K 15.)

16. *Tombigbee River above Columbus, Mississippi.*—The present project for the improvement of this portion of the river was adopted in 1873, the object being to give good high-water navigation by the removal of snags and overhanging trees from Columbus to Fulton. The old channel was so difficult and dangerous to navigate as to prevent steamers even during high freshets from running above Aberdeen.

The expenditure of $21,818.33 to June 30, 1881, has resulted in so opening the river that during last high-water season light-draught boats were enabled to run to Fulton, and bring down about 2,800 bales of cotton from that section of the country, and deliver a corresponding amount of plantation supplies.

The amount available June 30 is deemed sufficient to complete the improvement as contemplated.

The amount asked for is required to preserve the improvement by the removal of occasional landslides, &c., after the freshets.

July 1, 1880, amount available	$15,076 73	
Amount appropriated by act approved March 3, 1881	1,000 00	
		$16,076 73
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		6,228 01
July 1, 1881, amount available		9,848 72
Amount (estimated) required for completion of existing project		8,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		2,000 00

(See Appendix K 16.)

17. *Noxubee River, Mississippi.*—The present project for the improvement of this river was adopted in 1880, the object being to afford a navigable channel for small river steamers from its mouth to Macon, Miss., during about nine months in the year, when the water is a little above low-water stage. The present channel is not navigable except after a considerable rise, and then only a short distance up. Under an appropriation of $12,000, made by act of Congress approved June 14, 1879, the work of improving this river, under the adopted plan, was commenced in August, 1880, and suspended in December, 1880, on account of high-water until March, 1881, when the work was resumed and continued to the close of the fiscal year.

During the year the work of improvement was carried over about 38 miles of river.

Owing to the excessive rains which occurred during the progress of the work, operations were seriously retarded.

By act of March 3, 1881, an appropriation of $8,000 was made for this improvement, which amount it is proposed to expend during this fiscal year in continuing the work as heretofore in making a high-water channel from the mouth of river to the county bridge at Macon, Miss.

To make this river navigable for about seven months of the year, which would satisfy the immediate demands of commerce, about $25,000 would be required.

July 1, 1880, amount available	$12,000 00	
Amount appropriated by act approved March 3, 1881	8,000 00	
		$20,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		12,361 16
July 1, 1881, amount available		7,638 84
Amount (estimated) required for completion of existing project		45,245 25
Amount that can be profitably expended in fiscal year ending June 30, 1883.		25,000 00

(See Appendix K 17.)

18. *Pascagoula River, Mississippi.*—The present project for the improvement of this river was adopted in 1880, the object being to afford a channel 200 feet wide and 7 feet deep at mean low-water from Mississippi Sound into East Pascagoula River, and to improve the river above by the removal of snags and overhanging trees. The natural channel had a depth of not more than 3 feet at its shoalest part.

The amount expended to June 30, 1881, is $25,570.44, including outstanding liabilities, and has resulted in securing a channel 100 feet wide, with a depth of not less than 7 feet through the bar at the mouth of the river.

The amount available and the appropriation of $20,000 asked for is to be applied to widening the cut through the bar to 200 feet and to clear the river above of overhanging trees and snags, which will complete the improvement as projected, and also remove some shoals in the river between its mouth and Moss Point, not originally proposed but very much needed.

July 1, 1880, amount available	$42,424 20	
Amount appropriated by act approved March 3, 1881	4,000 00	
		$46,424 20
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	23,915 56	
July 1, 1881, outstanding liabilities	79 08	
		23,994 64
July 1, 1881, amount available		22,429 56

Amount (estimated) required for completion of existing project............	$20,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	20,000 00

(See Appendix K 18.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with provisions of the river and harbor act of March 3, 1879, Captain Damrell was charged with and has completed the following, the results of which were transmitted to Congress and printed in Senate Ex. Doc. No. 42, Forty-sixth Congress, third session.

1. *Warrior, from Tuscaloosa to forks of Sipsey and Mulberry, Alabama.* (See Appendix K 19.)
2. *Sipsey River, Alabama.* (See Appendix K 20.)
3. *Coosa River from the bridge of the Selma, Rome, and Dalton Railroad to Wetumpka, Alabama.* (See Appendix K 21.)

And to comply with provisions of river and harbor act of June 14, 1880, he was charged with and has completed the following:

1. *Tallapoosa River from the junction of Coosa up to Tallassee, Alabama.*
2. *Tallapoosa River from the city of Montgomery to Tallassee*, the results of both of which were transmitted to Congress and printed in House Ex. Doc. No. 80, Forty-sixth Congress, third session. (See also Appendix K 22.)
3. *Cahaba River, Alabama, from its mouth in Dallas County.* (See Appendix K 23.)

And to comply with the same act he was also charged with the following, the results of which will be duly transmitted when received.

4. *Finholloway River, Florida.*
5. *Aucilla and Wacissa, Florida.*
6. *Chipola River, Florida.*
7. *Ocolockonee River, Florida.*
8. *Holmes Creek, Florida.*
9. *East Bay and Blackwater River, Florida.*

He is also charged with, to comply with provisions of the river and harbor act of March 3, 1881, and is now engaged upon, the following, the results of which will also be duly submitted when received.

1. *Tombigbee River, Mississippi, from Fulton to Warren's Mill.*
2. *The Chattahoochee River in Georgia, between West Point and Bolten, on the Western and Atlantic Railroad, so as to complete the survey of that portion of the river.*
3. *Dog Island Harbor; harbor of Key West; Crystal River; Lagrange Bayou, up to Freeport; Manatee River, and Crooked River, Florida.*
4. *Outlet of harbor of Ship Island.*
5. *Harbor at Biloxi, Mississippi.*
6. *Harbor at Pascagoula, Mississippi.*

INSPECTION OF THE IMPROVEMENT AT THE SOUTH PASS OF THE MISSISSIPPI RIVER.

Inspecting officer, Capt. W. H. Heuer, Corps of Engineers.

Examinations and surveys to ascertain the depths of water and width of channel secured and maintained from time to time by James B. Eads, at South Pass, and whether and to what extent, within a distance of 5 miles from the present mouth of the river at the South Pass, the gulf has filled up by deposits from the river since the construction of the Eads jetties. The inspecting officer, in his annual report dated July 18, 1881, states that there was, through the jetties, during the entire fiscal year, a channel 30 feet deep having a least width of 20 feet, and that the 26-foot deep channel had a least width of 200 feet. The least width of this channel at that date was 230 feet.

Outside and beyond the jetties the least width of the 30-foot-deep channel was 60 feet, while the 26-foot deep channel had a least width of 210 feet except for a very few days during the year, when the channel was somewhat narrower.

Above the jetties and through the Pass itself the least channel depth was, at the date of the report, 27 feet, and its least width 160 feet. A channel 26 feet deep was maintained through the Pass during the fiscal year.

At the date of the report there was a channel from the main river into the Gulf, whose least depth was 27 feet and least width 160 feet.

The bed of the Pass has in some places scoured and in others filled. During the year the fill has exceeded the scour by about one-tenth of a foot only, measured vertically. From June, 1875, to October, 1880, in a little more than five years, the average depth of fill in the Pass was 2.5 feet. As a rule the filling has occurred most where the Pass was widest, and rarely has any filling occurred in the channel where the depth was less than 27 feet, much of the fill having lodged in the deeper pockets of the Pass.

The most interesting and important facts developed in the examinations and surveys made during the fiscal year relate to the changes that have occurred in the fan-shaped area in the Gulf of Mexico beyond the outer ends of the jetties and extending out to 100 feet depth of water.

From June 30, 1879, to June 30, 1880, the separate surveys of this area compared with each other showed an average scour during the year of 0.12 of a foot, an amount so small as to be practically nothing; but this year, from June, 1880, to June, 1881, instead of a scour there has been an average deposit or fill over this large area ($1\frac{1}{4}$ square miles) of 2.38 feet.

July 1, 1880, amount available	$25,156 22	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$35,156 22
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		12,859 88
July 1, 1881, amount available		22,296 34
Amount that can be profitably expended in fiscal year ending June 30, 1883		16,500 00

(See Appendix L.)

IMPROVEMENT OF HARBOR AT NEW ORLEANS; OF PEARL RIVER, MISSISSIPPI; OF BAYOUS TECHE AND BLACK, AND OTHER WATER-COURSES IN LOUISIANA—CONNECTION OF BAYOU TECHE WITH GRAND LAKE AT CHARENTON.

Officer in charge, Maj. C. W. Howell, Corps of Engineers, with Capt. D. W. Lockwood, Corps of Engineers, under his immediate orders.

1. *Harbor at New Orleans, Louisiana.*—The project for the improvement of this harbor is that adopted by the Board of Engineers, convened at the request of the city authorities of New Orleans to consider plans for the protection of the harbor front from the effects of caving banks of the Mississippi along that front. (See Report of the Chief of Engineers, 1878, vol. i, Appendix J 10.)

The amount expended to June 30, 1881, is $61,524.55, including $7,241.16 paid city of New Orleans for surveying, and has resulted in covering 47,575.64 square yards of the slope of the river bed, in harbor front of third district, or section 2 of the survey of the Board of Engineers, mentioned above.

The work of protecting the banks of the river has been attended with much difficulty, owing to its peculiar character and the many obstacles interposed by the crowded condition of the harbor, the movements of shipping, &c. The officer in charge reports that the work so far has not been continuous to an extent sufficient to warrant a statement either for or against the success of mats, as a sure means of protecting the river banks from caving. He thinks that definite information upon this point will be obtained from the work in progress at the Carrollton Bend, where there are no wharves or shipping to interfere with the work.

To continue the work of improvement an additional appropriation of $200,000 is recommended for the fiscal year ending June 30, 1883.

The whole subject has, however, been recommitted to a Board of Engineers for consideration, and on the receipt of their report it will be submitted with recommendation as to the further prosecution of the work, and the application of the available money, including the appropriation of March 3, 1881.

July 1, 1880, amount available	$133,088 77	
Amount appropriated by act approved March 3, 1881	75,000 00	
		$208,088 77
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	9,467 30	
July 1, 1881, outstanding liabilities	146 02	
		9,613 32
July 1, 1881. amount available		198,475 45
Amount (estimated) required for completion of existing project		216,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		200,000 00

(See Appendix M 1.)

2. *Pearl River, from Jackson to Carthage, Mississippi.*—The original project for this improvement was adopted in 1879, the object being to obtain a navigable channel at a 5-foot stage of water, by removal of obstructions to navigation in worst places. The natural channel is much obstructed by snags, sunken logs, rafts, standing trees in the water, and overhanging trees on the banks, which will have to be removed.

The present project was adopted in 1880, the object being to obtain a channel of navigable width and 5 feet depth at low-water.

Owing to high-water no material progress has been made beyond commencement up to the end of the fiscal year. Contracts are now in force for work under the appropriation of March 3, 1879, ($6,000), and that of June 14, 1880 ($7,500).

Proposals were invited for continuing the work under the appropriation of 1881, but no bids received.

The additional amount required to complete the work, beyond what has already been appropriated, is $5,000. The amount available for contracts being but $2,500, it is proposed to await further appropriations.

July 1, 1880, amount available	$13,286 97	
Amount appropriated by act approved March 3, 1881	2,500 00	
		$15,786 97
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1881		202 11
July 1, 1881, amount available		15,584 86
Amount (estimated) required for completion of existing project		5,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		5,000 00

(See Appendix M 2.)

3. *Pearl River below Jackson, Mississippi.*—The present project for this improvement was adopted in 1880, the object being to obtain a channel of navigable width and 5 feet depth at low-water.

The natural channel is much obstructed by snags, sunken logs, rafts, standing trees in the water, and overhanging trees on the banks, which will have to be removed.

The first appropriation for this work was made by act of June 14, 1880, but work by contract under it, owing to continued high-water, had been but fairly commenced at the end of the fiscal year.

It is proposed to apply the appropriation of March 3, 1881, and the amount recommended for the fiscal year ending June 30, 1883, to continuing the work of improvement now under contract, and covering 195 miles of river down stream from Jackson.

July 1, 1880, amount available	$30,000 00	
Amount appropriated by act approved March 3, 1881	25,000 00	
		$55,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	956 87	
July 1, 1881, outstanding liabilities	235 33	
		1,192 20
July 1, 1881, amount available		53,807 80
Amount (estimated) required for completion of existing project		40,940 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		41,000 00

(See Appendix M 3.)

4. *Amite River, Louisiana.*—The present project for this improvement was adopted in 1880, the object being to obtain a channel of navigable width and 5 feet depth at low-water, or as near that as practicable without dredging.

The natural channel is much obstructed by snags, sunken logs, rafts, standing trees in the water, and overhanging trees on the banks, which will have to be removed.

The first appropriation for this work was made by act of June 14, 1880, but the work by contract under it, owing to continued high-water, had, at the end of the fiscal year, only progressed 6½ miles.

It is proposed to apply the appropriation of March 3, 1881, and the amount recommended for the fiscal year ending June 30, 1883, to continuing the work of improvement now under contract and covering 40 miles of river up stream from its junction with Bayou Manchac.

July 1, 1880, amount available	$8,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$13,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		154 27
July 1, 1881, amount available		12,845 73
Amount (estimated) required for completion of existing project		10,760 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		10,800 00

(See Appendix M 4.)

5. *Vermillion River, Louisiana.*—The present project for this work was adopted in 1880, and modified in 1881, the object being to obtain a channel of navigable width and depth from the railroad bridge above Vermillionville to Vermillion Bay.

The natural channel is at present much obstructed by snags, sunken logs, and overhanging trees, and the mouth in Vermillion Bay by a mud bar.

The contractor under appropriation of 1880 commenced work July, 1881.

Bids for continuing the work under appropriation of 1881 were opened July 30, and contract awarded.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	4,900 00	
		$9,900 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		113 54
July 1, 1881, amount available		9,786 46

(See Appendix M 5.)

6. *Tangipahoa River, Louisiana.*—The present project for this improvement was adopted in 1880, the object being to obtain a channel of navigable width and 5 feet depth at low-water, or as near that as practicable without dredging.

The natural channel is much obstructed by snags, sunken logs, rafts, standing trees in the water, and overhanging trees on the banks, which will have to be removed.

The first appropriation for this work was made by act of June 14, 1880, but the work by contract under it, owing to continued high-water, had, at the end of the fiscal year, only progressed 6½ miles.

It is proposed to apply the appropriation of March 3, 1881, and the amount recommended for the fiscal year ending June 30, 1883, to continuing the work of improvement now under contract and covering 34 miles of the river from its mouth up.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	2,000 00	
		$7,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		156 09
July 1, 1881, amount available		6,843 91
Amount (estimated) required for completion of existing project		3,700 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		3,700 00

(See Appendix M 6.)

7. *Tchefuncte River, Louisiana.*—The present project for this work was adopted in 1881, the object being to obtain a channel of navigable width and depth from the Old Landing to Covington.

The natural channel is much obstructed by snags and overhanging trees.

Bids for this work under the appropriation of 1881 were opened July 30 and contract awarded.

To complete the work under existing project an additional appropriation of $3,960 is recommended for fiscal year ending June 30, 1883.

Amount appropriated by act approved March 3, 1881	$1,500 00
July 1, 1881, amount available	1,500 00
Amount (estimated) required for completion of existing project	3,960 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	4,000 00

(See Appendix M 7.)

8. *Tickfaw River, Louisiana.*—The present project for this work was

adopted in 1881, the object being to obtain a channel of navigable width and depth for a distance of 26 miles up stream from its mouth.

The natural channel is much obstructed by snags and overhanging trees.

Bids for the work under the appropriation of 1881 were opened July 30, 1881, and a contract awarded.

The appropriation asked for is to complete the work under the present project.

Amount appropriated by act approved March 3, 1881	$2,000 00
July 1, 1881, amount available	2,000 00
Amount (estimated) required for completion of existing project	8,230 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	8,200 00

(See Appendix M 8.)

9. *Bayou Teche, from Saint Martinsville to Port Barre, Louisiana.*—The present project for this work was adopted in 1880 and modified in 1881, its object being to secure low-water navigation of the bayou.

The natural channel was obstructed by snags, sunken logs, and overhanging trees.

The amount expended to date is $5,867.34, and has resulted in clearing the bayou of obstructions from Saint Martinsville to Leonville.

To carry low-water navigation to the latter place will require three dams and locks, and the amount appropriated March 3, 1881, together with the amount recommended for the fiscal year ending June 30, 1883, is deemed sufficient to complete the work under this project.

July 1, 1880, amount available	$6,000 00	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$26,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	164 84	
July 1, 1881, outstanding liabilities	5,702 50	
		5,867 34
July 1, 1881, amount available		20,132 66
Amount (estimated) required for completion of existing project		30,690 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		30,700 00

(See Appendix M 9.)

10. *Connection of Bayou Teche with Grand Lake at Charenton, Louisiana.*—To continue the work, an appropriation of $50,000 is asked for fiscal year ending June 30, 1883, which is to be applied to completing the trunk of the canal and building the lock near the Teche.

The appropriation of $25,000 of March 3, 1881, for this work was based upon an examination provided for by joint resolution of Congress of June 18, 1879. The plan of improvement adopted is the construction of a canal to connect the two waters, about 6,594 feet in length, 50 feet wide at bottom, slope 1 on 2, and navigable depth, at mean low-tide of ordinary low-water, of 5 to 6 feet, and one lock with double gates. The approximate estimate of cost is $73,196.

It is proposed to apply the appropriation of March 3, 1881, to securing the land needed for the canal, and to so much of the excavation and embankment of its trunk as the funds will admit.

Amount appropriated by act approved March 3, 1881	$25,000 00
July 1, 1881, amount available	25,000 00
Amount (estimated) required for completion of existing project	50,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	50,000 00

(See Appendix M 10.)

11. *Bayou Black, Louisiana.*—The appropriation of March 3, 1881, is the first made for this work. No project for its application has as yet been decided upon, on account of the examination provided for in act of June 14, 1880, not having been completed until near the close of the fiscal year. The approximate estimate for this improvement resulting from this examination is $47,520.

To clear the bayou so as to afford a navigable channel for commercial purposes, dredging will have to be resorted to for a distance of about 25 miles above Tigerville; overhanging trees will also have to be removed.

The officer in charge recommends that the balance of the above estimate ($37,520) be appropriated for the fiscal year ending June 30, 1883, for completing the work.

Amount appropriated by act approved March 3, 1881	$10,000 00
July 1, 1881, amount available	10,000 00
Amount (estimated) required for completion of existing project	37,520 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	37,500 00

(See Appendix M 11.)

12. *Bayou Courtableau, from Port Barre to Atchafalaya, Louisiana.*—The present project for the improvement of this bayou was adopted in 1881, its object being to insure low-water navigation, 1st between the Courtableau and the Atchafalaya by the cutting out of Little Devil Bar; and 2d, up the Courtableau by a dam and lock at the proper point.

The Courtableau at low-water is much obstructed near its mouth in the Atchafalaya by a sand-bar that forms during high-water, frequently cutting off all communication between the two streams, and it is proposed to remove this by closing the principal run-out bayous in the Courtableau, and thus force all its water out through its mouth.

The original estimate for closing the bayous was $20,000; and for removing snags and constructing one lock and dam, and contingencies, $19,490, in all, $39,490, of which $15,000 have been appropriated. An additional appropriation of $25,000 is recommended to complete the work as projected.

July 1, 1880, amount available	$7,500 00	
Amount appropriated by act approved March 3, 1881	7,500 00	
		$15,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		1,218 61
July 1, 1881, amount available		13,781 39
Amount (estimated) required for completion of existing project		25,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		25,000 00

(See Appendix M 12.)

13. *Bayou Terrebonne, Louisiana.*—The present project for the improvement of this bayou was adopted in 1880, the object being to obtain a channel of navigable width and 4 feet depth at low-water from Houma down. The natural channel at low-water is very narrow and much obstructed by shoals and sunken logs.

The amount expended to June 30, 1881, is $9,042.14, and has resulted in securing a channel 38 to 40 feet wide, with a depth of not less than 4 feet at low-water for 7½ miles, leaving 16 miles yet to be improved to reach Houma.

The appropriation of $15,000, asked for, is to be applied in extending the dredged channel to Houma, and in making "turn arounds" at suitable points where needed.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	8,800 00	
		$18,800 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	6,735 03	
July 1, 1881, outstanding liabilities	2,307 11	
		9,042 14
July 1, 1881, amount available		9,757 86
Amount (estimated) required for completion of existing project		15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		15,000 00

(See Appendix M 13.)

14. *Bayou Lafourche, Louisiana.*—The present project for the improvement of this bayou was adopted in 1879, the object being to afford low-water navigation of the lower bayou by removal of all obstructions, such as snags, wrecks, and raft-heaps, with which the natural channel was much obstructed from Donaldsonville down.

The amount expended to June 30, 1881, is $16,223.23, and has resulted in clearing the bayou to a point 8 miles below Lockport.

No appropriation is asked for fiscal year ending June 30, 1883, as the balance on hand is sufficient to carry out the present project.

July 1, 1880, amount available		$13,005 17
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$4,160 90	
July 1, 1881, outstanding liabilities	67 50	
		4,228 40
July 1, 1881, amount available		8,776 77

(See Appendix M 14.)

15. *Calcasieu River, from Phillips' Bluff to its mouth.*—The present project for this work was adopted in 1881, the object being to obtain a channel of navigable width and depth from Phillips' Bluff to the mouth of the river. The natural channel is much obstructed by snags, sunken logs, and overhanging trees.

Bids for this work were opened July 30, but, the only bid received being informal, no contract was awarded.

The amount available for this work not being sufficient to warrant the purchase of the plant necessary for the commencement of the work with hired labor, it became necessary to await further appropriations, and $7,080 is asked for the fiscal year ending June 30, 1883, for the completion of the plan adopted.

Amount appropriated by act approved March 3, 1881	$3,000 00
July 1, 1881, amount available	3,000 00
Amount (estimated) required for completion of existing project	7,080 00
Amount that can be profitably expended in fiscal year ending June 30, 1883..	7,000 00

(See Appendix M 15.)

16. *Calcasieu Pass, Louisiana.*—The present project for this work was adopted in 1881, being a modification of the one adopted in 1872, the object being to obtain a channel of navigable width and depth across the flat at the foot of Calcasieu Lake.

The cut dredged in 1873 and 1874 has filled up considerably, and it is proposed to open and extend it.

The work was advertised for contract, and bids opened July 30 and a contract awarded.

Amount appropriated by act approved March 3, 1881	$12,000 00
July 1, 1881, amount available	12,000 00
Amount (estimated) required for completion of existing project	3,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883..	3,000 00

(See Appendix M 16.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with provisions of the river and harbor act of June 14, 1880, Major Howell was charged with and has completed the following:

1. *Black Bayou, Louisiana.* (See Appendix M 11.)
2. *Calcasieu River, Louisiana*, printed in House Ex. Doc. No. 46, Forty-sixth Congress, third session. (See also Appendix M 15.)
3. *Bayou André, Louisiana.* (See Appendix M 17.)
4. *Litttle Lake, Louisiana.* (See Appendix M 18.)
5. *Barataria Bay, from New Orleans to Grand Pass.* (See Appendix M 18.)

And to comply with provisions of the river and harbor act of March 3, 1879, he was charged with and is still engaged upon—

Survey and estimate for a breakwater to be constructed from a point at or near the new canal outlet near New Orleans, Louisiana, to the Pontchartrain Railroad wharf, said breakwater to be so constructed as to serve as a harbor of refuge for all vessels.

And, also to comply with provisions of the river and harbor act of June 14, 1880, he is charged with and is now engaged upon the following, the results of which, as well as those of the above, will be duly submitted when received:

1. *Atchafalaya River, Louisiana.*
2. *Bogue Chitto River, Louisiana.*
3. *Bogue Falia, Louisiana.*
4. *West Pearl River, Louisiana.*
5. *Pass Manchac and Bayou Manchac, Louisiana, from its mouth to the Mississippi River.*
6. *Bayou Plaquemine, Louisiana.*
7. *Grand Caillou Bayou.*
8. *Little Caillou Bayou, Louisiana.*
9. *Bayou Fusilier, Louisiana.*
10. *Grand Lake, Louisiana.*

IMPROVEMENT OF SABINE PASS AND BLUE BUCK BAR, AND OF THE SABINE AND NECHES RIVERS, TEXAS.

Officer in charge, Capt. C. E. L. B. Davis, Corps of Engineers, since June 16, 1881.

1. *Sabine Pass and Blue Buck Bar, Texas* (in charge of Maj. C. W. Howell, Corps of Engineers, to June 16, 1881).

Originally there was a channel of but 6 or 7 feet at Sabine Pass.

The project for improvement, adopted in 1875 and modified in 1877, had for its object the obtaining of a channel of sufficient width for purposes of navigation, and at least 12 feet in depth.

The amount expended up to June 30, 1881, $153,023.88, has resulted in securing a 12-foot channel from the gulf to Sabine Harbor, which, owing to the soft material of the bottom and the short distance on the bar where less than 15 feet is found, would admit of the entrance of steam vessels drawing somewhat more than the depth of the channel.

During the fiscal year the sum of $41,837 was expended in the effort to procure and maintain a channel of greater depth than 12 feet. The work, however, was very difficult, owing to the loss of time incurred by unfavorable weather and the delays arising from the length of time required for repairs of machinery and the procurement of the requisite fuel for working it. The locality is much exposed and isolated, the nearest port of supply being New Orleans.

The material forming the bottom of the channel is very soft, and constant dredging is required to prevent its filling up. Measures for the preservation of the channel are under consideration; among others, the construction of jetties with a view to contracting the width of the entrance and thus increasing the scour, &c.

The estimated amount for the entire and permanent completion of this work of improvement has not been accurately determined as yet.

July 1, 1880, amount available	$64,775 14	
Amount appropriated by act approved March 3, 1881	150,000 00	
		$214,775 14
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	41,837 09	
July 1, 1881, outstanding liabilities	12,961 93	
		54,799 02
July 1, 1881, amount available		159,976 12
Amount that can be profitably expended in fiscal year ending June 30, 1883		250,000 00

(See Appendix N 1.)

2. *Sabine River*, *Texas* (in charge of Maj. S. M. Mansfield, Corps of Engineers, to June 16, 1881).

Prior to improvement, the mouth of the river was barred to 3½ feet depth. The original project for improvement (1871, modified in 1873) was to deepen the main outlet of the river, so as to admit the entrance of vessels drawing 5 feet, and to accommodate the commerce of the region through which the river runs.

The amount expended to June 30, 1880, was $44,982.13, and resulted in opening the river to navigation from Sabine Lake to Orange, Tex.

The amount expended during the year ending June 30, 1881, was $82.03, for contingencies.

The unappropriated balance of the original estimate, $14,000, can be profitably expended in the year ending June 30, 1883, in continuing improvements, viz, deepening and widening the channel at the mouth, and removing obstructions to navigation in the river above.

The estimated amount required for the completion of the work of improvement, in accordance with adopted project, is $14,000. The work is, however, of a character not susceptible of permanent completion.

July 1, 1880, amount available	$11,017 87	
Amount appropriated by act approved March 3, 1881	7,000 00	
		$18,017 87
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		82 03
July 1, 1881, amount available		$17,935 84
Amount that can be profitably expended in fiscal year ending June 30, 1883		14,000 00

(See Major Mansfield's annual report, Appendix O 1.)

3. *Neches River*, *Texas* (in charge of Maj. S. M. Mansfield, Corps of Engineers, to June 16, 1881).

Before improvement, the depth across the bar at the mouth of the river was 2½ feet.

The project of 1873 was adopted with a view to opening up the river to navigation, and to increase the depth across the bar at the mouth of the river to 5 feet.

To June 30, 1880, there had been expended $12,892.70, which resulted in temporarily securing a channel across the bar of 5 feet in depth at mean low-tide.

The amount expended during the year ending June 30, 1881, was $99.74, for contingencies.

The unappropriated balance of the original estimate, $18,318, can be profitably expended in the year ending June 30, 1883, in continuing improvements, viz, removing snags, overhanging trees, &c., and in dredging channel at the mouth of the river.

The estimated amount required for the completion of the work of improvement, in accordance with the approved and adopted project, is $18,318.05.

The work is not susceptible of permanent completion, therefore estimates will vary from time to time as the improvement progresses.

July 1, 1880, amount available	$5,107 30	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$8,107 30
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		99 74
July 1, 1881, amount available		8,007 56
Amount that can be profitably expended in fiscal year ending June 30, 1883.		18,300 00

(See Major Mansfield's annual report, Appendix O 2.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with the provisions of the river and harbor act of March 3, 1881, Captain Davis has been charged with, and is now engaged upon, the following, the results of which will be duly submitted when received:

1. *Sabine Pass, Texas, through Sabine Lake and River, to Orange and Sabine Lake, and the Neches to Beaumont, to ascertain the cost and practicability of a deep-water channel from Sabine Pass to Orange and Beaumont.*

IMPROVEMENT OF RIVERS AND HARBORS IN THE STATE OF TEXAS.

Officer in charge, Maj. S. M. Mansfield, Corps of Engineers, having under his immediate orders Capt. C. E. L. B. Davis, Corps of Engineers, until June 13, 1881.

1. *Entrance to Galveston Harbor, Texas.*—The work of improvement projected in 1874 has had for its object the deepening of the inner and outer bars, by contracting the outflowing current upon a less extent of bar, to thereby effect its removal and prevent for some time to come its reformation.

The amount expended to June 30, 1880, $618,413.75, has resulted in obtaining and maintaining a good channel of 20 feet over the inner bar where there was but about 11 feet, and the partial construction of the outer-bar jetties.

During the year ending June 30, 1881, there was expended $194,776.84 in constructing the south jetty.

The unappropriated balance of approved estimate is $1,400,813, of which amount $500,000 can be profitably expended in the fiscal year ending June 30, 1883, in constructing south jetty.

July 1, 1880, amount available	$209,568 29	
Amount appropriated by act approved March 3, 1881	250,000 00	
		$459,568 29
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	184,776 84	
July 1, 1881, outstanding liabilities	10,000 00	
		194,776 84
July 1, 1881, amount available		264,791 45
Amount (estimated) required for completion of existing project		1,400,813 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		500,000 00

(See Appendix O 3.)

2. *Ship-channel in Galveston Bay, Texas.*—The natural channel through the bay had a depth of not more than 7 feet at the shoalest place.

The adopted project for the improvement (1871, modified in 1877) had for its object the deepening and widening of the channel from the head of Bolivar Channel to the cut through Morgan's Point, to afford a channel 100 feet wide at bottom and 12 feet deep at mean low-tide.

The amount expended to June 30, 1880, was $176,886.39, by which has been secured a navigable channel from the Gulf to the upper bay, with a depth of not less than 9 feet.

During the year ending June 30, 1881, there was expended $1,834.87, for contingencies.

The unappropriated balance of the oringinal and modified estimate, viz, $94,326.42, can be profitably expended in the year ending June 30, 1883, in continuing operations, completing the channel required. This amount, $94,326.42, is considered sufficient o make the complete and entire improvement projected, at least for the next few years. The work cannot be considered of an entirely permanent character.

July 1, 1880, amount available	$155,313 61	
Amount appropriated by act approved March 3, 1881	50,000 00	
		$205,313 61
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		1,834 87
July 1, 1881, amount available		203,478 74
Amount (estimated) required for completion of existing project		94,326 42
Amount that can be profitably expended in fiscal year ending June 30, 1883		95,000 00

(See Appendix O 4.)

3. *Trinity River, Texas.*—The natural channel at the mouth of the river was shoal—4½ feet—and extremely narrow across the bar.

The project (adopted in 1871 and modified in 1873) had for its object the opening of the river to navigation so as to admit the entrance of vessels drawing 5 feet.

The amount expended to June 30, 1880, was $6,196, and resulted in temporarily deepening the channel across the bar at the mouth.

The amount expended during the year ending June 30, 1881, was $5,734.44, by which was gained a dredged channel of not less than 5½ feet depth, averaging 110 feet in width, and in length across the bar 4,800 feet.

Twenty-six thousand five hundred and forty-one dollars can be profitably expended in the year ending June 30, 1883, in continuing operations—dredging, removing snags, &c., as may be deemed necessary.

The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is $26,541.

This work not being susceptible of permanent completion, the estimate for continuing operations is indeterminate.

July 1, 1880, amount available	$10,304 00	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$20,304 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		5,734 44
July 1, 1881, amount available		14,569 56
Amount that can be profitably expended in fiscal year ending June 30, 1883		26,000 00

(See Appendix O 5.)

4. *Buffalo Bayou, Texas.*—From the report of examination of this tide-water stream, made in compliance with requirements of the river and harbor act of June 14, 1880, it is shown that the original channel-way, below Houston, is navigable for vessels drawing 6 feet of water.

The adopted project is simply to increase the depth and width of this channel, and to open it up for commercial purposes.

The estimate is for a channel 12 feet deep and 100 feet wide, to be made by dredging, the channel as it is developed, to be protected at points by sheet-piling, and the banks to be relieved of all overhanging trees, &c., tending to form obstructions to navigation.

The first work upon this improvement will be done under contract, to commence in September, 1881, and will consist of dredging and removing obstructions to navigation.

One hundred thousand dollars can be profitably expended in the fiscal year ending June 30, 1883, and with this amount it is expected to materially deepen and enlarge the present natural channel and aid commerce.

The estimated amount for the entire and permanent completion of this work of improvement is $385,299.75, of which sum $25,000 is now available.

Amount appropriated by act approved March 3, 1881	$25,000 00
July 1, 1881, amount available	25,000 00
Amount (estimated) required for completion of existing project	360,299 75
Amount that can be profitably expended in fiscal year ending June 30, 1883	100,000 00

(See Appendix O 6.)

5. *Channel over bar at mouth of Brazos River, Texas.*—The natural channel across the bar affords a depth of not over 8 feet, and is subject to constant changes, due to winds, tide, and stages of water in the river.

The project for the improvement (adopted in 1880) has for its object the maintenance of a good navigable channel across the bar.

The amount expended up to the close of the fiscal year ending June 30, 1881, $16,205.26, has been applied to constructing the north channel jetty. No appreciable effect can be had until the jetty is further advanced into the Gulf and raised, when it is expected that the river discharge will be concentrated directly on the bar with increased velocity of current and consequent erosion of a deeper channel.

One hundred thousand dollars can be profitably expended in the year ending June 30, 1883, in building the jetties designed.

The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is $442,890.40.

July 1, 1880, amount available	$40,000 00	
Amount appropriated by act approved March 3, 1881	40,000 00	
		$80,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	16,205 26	
July 1, 1881, outstanding liabilities	20,794 74	
		37,000 00
July 1, 1881, amount available		43,000 00
Amount (estimated) required for completion of existing project		442,890 40
Amount that can be profitably expended in fiscal year ending June 30, 1883.		100,000 00

(See Appendix O 7.)

6. *Pass Cavallo Inlet to Matagorda Bay, Texas.*—The natural channel has a depth of water across the bar of between 8 and 9 feet.

The present project (adopted in 1879) has for its object the obtaining of a 12-foot channel across the bar, and to protect the head of Matagorda Island from abrasion.

The amount expended to June 30, 1880, $2,868.20, was applied to surveys and contingencies.

The amount expended during the year ending June 30, 1881, $29,453.41, has been applied to the construction of a south channel jetty. The jetty has not yet assumed the proper proportions for advantageous effect upon the bar.

Two hundred thousand dollars can be profitably expended during the year ending June 30, 1883, in continuing work on the south channel jetty in conformity with the approved project.

The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is $859,180.

July 1, 1880, amount available	$117,131 80	
Amount appropriated by act approved March 3, 1881	60,000 00	
		$177,131 80
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	29,453 41	
July 1, 1881, outstanding liabilities	87,678 39	
		117,131 80
July 1, 1881, amount available		60,000 00
Amount (estimated) required for completion of existing project		859,180 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		200,000 00

(See Appendix O 8.)

7. *Aransas Pass and Bay, up to Rockport and Corpus Christi, Texas.*—The channel across the bar maintained by natural causes is 7 to 8 feet in depth.

The project (adopted in 1879) has for its object the maintainence of a 12-foot (at mean low-water) channel over the bar, and the protection of the head of Mustang Island up to and beyond Turtle Cove.

The amount expended to June 30, 1880, was $7,694.99, and was applied to surveys, contingencies, and the purchase of necessary plant, buildings, &c., to enter upon the work of improvement adopted.

The amount expended during the year ending June 30, 1881, $92,305.01, has been applied to the building of a number of groin-jetties for the protection of the head of Mustang Island up to and beyond Turtle Cove, in conjunction with a mattress and stone breakwater along the channel face of Mustang Island, and also the construction of the south channel jetty. These works, together with a number of sand-fences erected on Saint Joseph and Mustang islands, have had an appreciable effect upon the channel over the bar.

Two hundred thousand dollars can be profitably expended in the fiscal year ending June 30, 1883, in continuing work upon the south channel jetty.

One million twenty thousand seven hundred and twenty-two dollars and fifteen cents is the estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project.

July 1, 1880, amount available	$92,305 01	
Amount appropriated by act approved March 3, 1881	80,000 00	
		$172,305 01
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	88,693 55	
July 1, 1881, outstanding liabilities	3,611 46	
		92,305 01
July 1, 1881, amount available		80 000 00
Amount (estimated) required for completion of existing project		1,020,722 15
Amount that can be profitably expended in fiscal year ending June 30, 1883.		200,000 00

(See Appendix O 9.)

8. *Harbor at Brazos Santiago, Texas.*—The depth of water across the bar at the entrance is maintained by natural causes at not over 7½ feet at high-tide.

The project now under consideration has for its object the deepening of the channel across the bar, and the maintenance of a suitable harbor inside the pass.

There is available for the work $100,000, and the amount required for expenditure in the fiscal year ending June 30, 1883, is $200,000. With these amounts combined, the work on jetties can be profitably pushed during the next fiscal year and during the fiscal year ending June 30, 1883.

The estimated amount required for the entire and permanent completion of this work is $578,084.50.

July 1, 1880, amount available	$25,000 00	
Amount appropriated by act approved March 3, 1881	75,000 00	
		$100,000 00
July 1, 1881, amount available		100,000 00
Amount (estimated) required for completion of existing project		578,084 50
Amount that can be profitably expended in fiscal year ending June 30, 1883.		200,000 00

(See Appendix O 10.)

9. *Protection of river-bank at Fort Brown, Texas.*—This work is designed to arrest the progress of encroachment which threatens not only to destroy the most valuable buildings at the post, but to break through into the lagoon, which would entirely change the channel of the river, and leave the greater portion of the post on the opposite side of the channel.

The amount expended to June 30, 1881, is $16,769.96, and has resulted, it is believed, in the complete protection of the government reservation from further encroachment of the river.

Repairs may be needed from time to time, and $2,000 should be appropriated for that purpose.

July 1, 1880, amount available	$1,295 14
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,065 10
July 1, 1881, amount available	230 04
Amount that can be profitably expended in fiscal year ending June 30, 1883	2,000 00

(See Appendix O 11.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with provisions of river and harbor act of March 3, 1879, Major Mansfield has submitted report upon:

1. *Canal connecting Galveston and Brazos River, Texas.* (See Appendix O 12.)

And to comply with provisions of river and harbor act of June 14, 1880, he has submitted a report upon:

1. *Buffalo Bayou, Texas, from Simm's Bayou to the mouth of White Oak Bayou at Houston, with estimates of cost of a channel* 12 *feet deep and* 100 *and* 150 *feet wide;* transmitted to Congress and printed as House Ex. Doc. No. 53, Forty-sixth Congress, third session. (See also Appendix O 6.)

And to comply with provisons of the river and harbor act of March 3, 1881, he is charged with and is now engaged upon the following, the results of which will be duly submitted when received:

1. *Matagorda Bay at the mouth of Saint Mary's Bayou, near the town of Matagorda, Texas.*
2. *From Brazos de Santiago, through Laguna Madre, to Point Isabel, Texas, to ascertain the cost and practicability of a deep-water channel from the anchorage at Brazos de Santiago to the railroad wharf at Point Isabel.*

WESTERN RIVERS.

PRESERVATION OF THE PORTS OF MEMPHIS, VICKSBURG AND NATCHEZ—IMPROVEMENT OF THE MOUTH OF RED RIVER; OF THE RAFT AND UPPER RED RIVER, LOUISIANA AND ARKANSAS; OF CERTAIN RIVERS IN MISSISSIPPI AND TENNESSEE—WATER GAUGES ON THE MISSISSIPPI AND ITS PRINCIPAL TRIBUTARIES.

Officer in charge, Maj. W. H. H. Benyaurd, Corps of Engineers.

1. *Mississippi River and Harbor at Memphis, Tennessee.*—Work on the protection of the water front was continued until a junction was made with the paved landing put in by the city authorities; the length of this protection work is 1,150 feet. Above the mouth of Wolf River work was started on the protection of the bank and the stoppage of the caving by a system of mattresses and screen work.

Before the work for the protection of the harbor of Memphis, the city front was being rapidly carried away by the action of the current, several blocks of valuable buildings, including mills and storehouses, had been washed into the river. The work where carried on has resulted in the stoppage of the caving.

The officer in charge states that in consequence of this work, improvements have been, and are now, in course of construction, amounting to $500,000, on the site of the bank which heretofore had been caving rapidly.

The amount expended to June 30, 1880, was $66,498.16, and during the fiscal year ending June 30, 1881 there has been expended $30,411.30.

It is intended to continue the bank protection during the coming season.

With the appropriation asked for, for the fiscal year ending June 30, 1883, it is intended to carry on the improvement as heretofore.

July 1, 1880, amount available	$31,501 84	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$16,501 84
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		30,411 30
July 1, 1881, amount available		16,090 54

Amount (estimated) required for completion of existing project	$57,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	57,000 00

(See Appendix P 1.)

2. *Mississippi River and Harbor at Vicksburg, Mississippi.*—The harbor of Vicksburg was destroyed by a cut-off which took place April 27, 1876. The project adopted for the improvement had for its object, first, to hold the main channel of the river as near as possible to the city, by revetting the delta point, and secondly, to dredge out the harbor.

The amount expended up to the close of the fiscal year ending June 30, 1880, was $133,212.82, and work has been continued upon the first-named object. The amount expended during the fiscal year ending June 30, 1881, was $21,140.23. The officer in charge states, that a recent examination made of the locality showed that the work thus far accomplished has succeeded in holding the delta point, as far as applied.

With the appropriation asked for, for the fiscal year ending June 30, 1883, it is proposed to commence the dredging out of the inner harbor.

July 1, 1880, amount available	$20,787 18	
Amount appropriated by act approved March 3, 1881	75,000 00	
		$95,787 18
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		21,140 23
July 1, 1881, amount available		74,646 95
Amount that can be profitably expended in fiscal year ending June 30, 1883.		200,000 00

(See Appendix P 2.)

3. *Mississippi River at Natchez and Vidalia, Mississippi.*—Operations were commenced last fall upon this work. The project adopted looked to the protection of the caving banks of the Mississippi above, which, if not checked, would ultimately destroy the harbors of Natchez and Vidalia.

With the appropriation of $40,000, made by act of June 14, 1880, work was started upon the revetment of the bank at Good Hope Landing, and continued down stream to the extent of the funds available. This year the operations will be continued upon the caving bank in Giles Bend.

The total amount expended up to the close of the fiscal year ending June 30, 1881, was $40,147.22.

With the appropriation asked for, for the fiscal year ending June 30, 1883, the revetment and protection of the caving bends will be carried on.

July 1, 1880, amount available	$40,000 00	
Amount appropriated by act approved March 3, 1881	50,000 00	
		$90,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		40,147 22
July 1, 1881, amount available		49,852 78
Amount (estimated) required for completion of existing project		849,600 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		150,000 00

(See Appendix P 3.)

4. *Mouth of Red River, Louisiana.*—Work was continued upon the outer and inner bars of Old River, for the purpose of keeping a navigable channel through the obstructions, otherwise this important outlet would have been entirely closed at low-water. The dredge-boat was stationed on the outer bar, and in Old River proper two tugs and a steamer were used.

Navigation was maintained through the entire low-water season, with the exception of a few slight detentions.

For the purpose of carrying out the recommendations of the Board of Engineers for Fortifications and for River and Harbor Improvements, &c., a party was engaged in making measurements and observations to determine the changes taking place in the channel of Old River and the Atchafalaya.

During the coming low-water season, it is proposed to continue the operations of keeping up a temporary channel through the bars in Old River. The measurement and observations will also be continued as above. A survey has also been ordered of Bayou Cut-off, as a means of communication between the Red and the Mississippi. This will be made in the course of the summer, and the report presented in time for the action of Congress.

The amount expended up to the close of the fiscal year ending June 30, 1880, was $29,120.

The amount expended during the fiscal year ending June 30, 1881, was $34,675.36.

No appropriation is asked for, as the amount on hand is sufficient to continue the dredging operations.

July 1, 1880, amount available	$160 880 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	34,675 36
July 1, 1881, amount available	126,204 64

(See Appendix P 4.)

5. *Removing raft in Red River, and closing Tone's Bayou, Louisiana.*—1. *Removal of raft in Red River, Louisiana.*—This work is for the maintenance of an open channel in Red River above Shreveport, formerly entirely blocked by the Red River raft, and the original project embraced the entire removal of this great obstruction.

There is now a good navigable channel through the raft region at all seasons of the year, though it is liable to be temporarily blocked during the flood stages of the river. For operations during the past season, the steamer Florence was sent to Shreveport in December, and was engaged during the winter and spring in breaking up and removing the new raft formation.

Three large rafts which entirely blocked the river, and 83 side jams and 193 snags were removed. The work is not permanent, and must be continued from year to year, owing to the great quantity of drift brought down on each flood from upper Red River.

2. *Closing Tone's Bayou, Louisiana.*—The object of this work is to close Tone's Bayou, which now takes away from Red River fully ¾ of its volume to the injury of the low-water navigation of that stream. The original project embraced the entire closure of the bayou.

As the allotment from the appropriation for building the earthen dam as recommended in last year's report was insufficient for the work the officer in charge was authorized to retain the amount, and to combine it with a sufficient amount from the next appropriation, for the purpose of building the dam and connecting with the levees on Red River. A low-water dam has been constructed, which has given good navigation in Red River during the low-water season, but it is desirable to effect the total closure of the bayou.

Proposals were opened on June 23, for building the dam.

The amount expended on these works up to the close of the fiscal year ending June 30, 1880, was $382,865.24.

The amount expended during the fiscal year ending June 30, 1881, was $5,452.12.

During the coming season it is proposed to build Tone's Bayou Dam, and employ the steamer Florence in keeping the river open during the flood season, and in removing certain portions of the old raft.

With the appropriation of $18,000 asked for, for the fiscal year ending June 30, 1883, it is proposed to keep the river open and remove old raft.

July 1, 1880, amount available	$26,634 76	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$36,634 76
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		5,452 12
July 1, 1881, amount available		31,182 64
Amount that can be profitably expended in fiscal year ending June 30, 1883.		18,000 00

(See Appendix P 5.)

6. *Removing obstructions from Red River, Louisiana.*—Work upon this improvement commenced in 1878, the object being to clear this important stream of all obstructions to safe navigation.

In addition to important work at the old Confederate raft, the Rapious and the Falls of Alexandria, 665 snags were removed, 768 leaning trees cut down, and 448 shore snags destroyed.

The new-snag boat provided for in the appropriation of June 14, 1880, will be completed in August, and will at once be sent to the Red River for service.

As the work must necessarily be continuous, new obstructions being added each year, no project with detailed estimate has been submitted.

The amount expended up to the close of the fiscal year ending June 30, 1880, was $47,500.

The amount expended during the fiscal year ending June 30, 1881, was $27,276.81. The appropriation of $28,000 asked for, for the fiscal year ending June 30, 1883, is to be applied to the removal of obstructions by the snag-boat. A portion of this amount will be needed in completing the outfit for the new boat.

July 1, 1880, amount available	$60,000 00	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$70,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		27,276 81
July 1, 1881, amount available		42,723 19
Amount that can be profitably expended in fiscal year ending June 30, 1883.		28,000 00

(See Appendix P 6.)

7. *Upper Red River, Arkansas, from Fulton to the head of the raft.*—Work upon the improvement of this section of Red River was commenced in 1879, the object being to remove the obstructions so as to afford safe navigation to steamboats at a time when there is sufficient water in the river for them to run.

For the work last season the crane machinery belonging to the Red River raft work was placed upon a flat-boat, and the operations were commenced at Fulton and continued down stream for about 130 miles, when they had to be suspended on account of high-water. During the time worked a number of drift-piles, which had accumulated on the sand-bars, were removed, and the snags and logs obstructing the channel were taken out.

With the balance of the funds on hand it is proposed the coming season to continue the work of removing the snags and other obstructions from the river.

The estimated cost of this improvement was $19,560.

The amount expended up to the close of the fiscal year ending June 30, 1880, was $5,776.34.

The amount expended during the fiscal year ending June 30, 1881, was $9,464.32.

No appropriation is asked for, for the fiscal year ending June 30, 1883.

July 1, 1880, amount available	$14,223 66
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	9,464 32
July 1, 1881, amount available	4,759 34

(See Appendix P 7.)

8. *Yazoo River, Mississippi.*—The work upon the Yazoo River consists in the removal of snags, logs, and other obstructions to the safe navigation of the stream.

Up to the 30th of June, 1880, 12 wrecks had been removed, and the navigation otherwise improved by the removal of a large number of snags, logs, &c.

During the past season the steamer T. B. Florence and the snag-boat John R. Meigs were both engaged in the river; 250 snags were removed, 2,194 leaning trees cut down, and five side jams and rack-heaps destroyed.

The amount expended up to June 30, 1880, was $107,000, and during the fiscal year ending June 30, 1881, there has been expended $13,266.15.

The amount, $20,000, asked for, for the fiscal year ending June 30, 1883, is intended to be applied in removing the obstructions from the river, for which purpose one of the snag-boats will be used.

July 1, 1880, amount available	$12,000 00	
Amount appropriated by act approved March 3, 1881	6,000 00	
		$18,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		13,266 15
July 1, 1881, amount available		4,733 85
Amount that can be profitably expended in fiscal year ending June 30, 1883		20,000 00

(See Appendix P 8.)

9. *Big Sunflower River, Mississippi.*—Previous to work by the government, the navigation of the Sunflower was rendered difficult by the existence of various shoal places and by snags, logs, and other obstructions. The project adopted looked to the improvement of the shoal places by means of wing-dams, and to the general improvement by the removal of existing obstructions.

The depth on the shoal places has been increased from 18 inches to over 3½ feet, and boats can now navigate at extreme low-water.

The amount expended up to the close of the fiscal year ending June 30, 1880, was $9,611.68.

During the past season wing-dams were constructed at Callao and Vick's Landing, increasing the depth of the channel at those places; and in addition 472 snags were removed and over 7,000 trees cut down.

The amount expended during the fiscal year ending June 30, 1881, was $18,123.83. With the appropriation of $15,000 asked for, for the fiscal year ending June 30, 1883, it is intended to continue the removal of obstructions and to improve the shoal places.

July 1, 1880, amount available	$18,388 32	
Amount appropriated by act approved March 3, 1881	4,000 00	
		$22,388 32
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		18,123 83
July 1, 1881, amount available,		4,264 49
Amount (estimated) required for completion of existing project		34,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		15,000 00

(See Appendix P 9.)

10. *Tallahatchee River, Mississippi.*—Work was commenced upon this improvement in September, 1879, and consisted in the removal of obstructions to the navigation of the stream. There has been no boat as high as Batesville since the war.

During the past season work was carried on upon two sections of the river, as provided for in the appropriation act of June 14, 1880, viz: between Batesville and the mouth of the Coldwater and upon the main river 685 snags and logs were removed and 4,387 trees cut down, rendering navigation now more safe and speedy than before, when there is sufficient water in the river for boating purposes.

The amount expended to June 30, 1880, was $4,177, and there was expended during the fiscal year ending June 30, 1881, $12,243.22.

With the amount asked for for the fiscal year ending June 30, 1883, it is proposed to continue the removal of obstructions.

July 1, 1880, amount available	$10,823 00	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$13,823 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		12,243 22
July 1, 1881, amount available		1,579 78
Amount (estimated) required for completion of existing project		22,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		6,000 00

(See Appendix P 10.)

11. *Coldwater River, Mississippi.*—This work was commenced in 1879, during which season the United States steamer T. B. Florence was engaged for a short time in removing the obstructions from the river.

For the work last season a flat-boat having the necessary machinery and outfit was chartered, and the operations were carried on from September to December 31, 1880; 296 logs, 132 snags, and 8 stumps were removed; 1,142 trees were cut down, 1,198 deadened, and 778 trimmed and topped; 4 rafts, 41 rack-heaps, and 7 drift-piles were cut out and destroyed, and a blockade 400 feet long was broken up.

During the coming season the balance of funds on hand will be expended in operating upon the lower stretch of the river.

The amount expended up to the close of the fiscal year ending June 30, 1880, was $2,218.05.

The amount expended during the fiscal year ending June 30, 1881, was $6,617.75.

No appropriation is asked for, for the fiscal year ending June 30, 1883.

July 1, 1880, amount available	$8,781 95
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	6,617 75
July 1, 1881, amount available	2,164 20

(See Appendix P 11.)

12. *Tchula Lake, Mississippi.*—No work has heretofore been done upon this improvement. With the appropriation of March 3, 1881, it is proposed to remove the obstructions from the bed and banks of the stream.

The appropriation asked for for the year ending June 30, 1883, will be applied to operations of the same character.

The estimated cost of this work was $10,000.

Amount appropriated by act approved March 3, 1881	$3,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	295 98
July 1, 1881, amount available	2,704 02
Amount (estimated) required for completion of existing project	7,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	5,000 00

(See Appendix P 12.)

13. *Yallabusha River, Mississippi.*—No work has heretofore been done upon this improvement. With the appropriation of March 3, 1881, it is proposed to remove the obstructions from the bed and banks of the stream. For this purpose a party was sent to the river early in June, and the necessary outfit was procured for commencing the work.

The amount expended to June 30, 1881, was $1,072.31.

With the appropriation asked for, for the fiscal year ending June 30, 1883, work will be carried on as above.

The estimated cost of the work was $7,000.

Amount appropriated by act approved March 3, 1881	$3,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,072 31
July 1, 1881, amount available	2,427 69
Amount (estimated) required for completion or existing project	3,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	3,500 00

(See Appendix P 13.)

14. *Big Hatchie River, Tennessee.*—Work upon this improvement commenced in August, 1880. The operations consisted in removing the snags, logs, and other obstructions from the bed and banks of the stream.

A party was organized and the work was started at Bolivar, and continued down stream to its mouth, which point was reached December 10, 1880.

The work, when completed, will allow boats to run from Memphis to Bolivar at all seasons of the year.

During the coming season it is proposed to continue the work as heretofore.

The original estimate for the improvement of the Hatchie was $30,000.

The total amount expended to June 30, 1881, is $7,323.46.

With the appropriation of $10,000 asked for, it is proposed to operate in removing the obstructions from the river.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	3,500 00	
		$13,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		7,323 46
July 1, 1881, amount available		6,176 54
Amount (estimated) required for completion of existing project		16,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		10,000 00

(See Appendix P 14.)

15. *Ouachita River, Arkansas and Louisiana.*—Previous to operations on the Ouachita, the stream was obstructed by snags, and various shoal places existed. The original project for the improvement embraced a series of locks and dams for slackwater navigation. This was afterwards abandoned and operations confined to the removal of obstructions and the improvement of the shoals.

The total amount expended on this latter, including cost of iron hull snag-boat, to close of fiscal year ending June 30, 1880, was $123,281.29.

Operations were continued during the season with the snag-boat Wagner, removing obstructions from the channel; 456 snags were removed and 4,159 trees cut down.

Work was also commenced and carried on at Catahoula Shoals. This point was the highest usually reached by boats at extreme low-water. The work so far as completed has deepened the channel, so that boats can now reach Columbia, 60 miles above, at all stages.

The amount expended during the fiscal year ending June 30, 1881, was $18,547.95.

The appropriation of $25,000 asked for, for the fiscal year ending June 30, 1883, is intended to continue the operations of the Wagner and the improvement of Catahoula Shoals.

No detailed estimates can be presented for operating the snag-boat, since the nature of the work renders it continuous from year to year, each flood bringing new obstructions into the stream.

July 1, 1880, amount available	$14,130 84	
Amount appropriated by act approved March 3, 1881	12,000 00	
		$26,130 84
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		18,547 95
July 1, 1881, amount available		7,582 89
Amount that can be profitably expended in fiscal year ending June 30, 1883		25,000 00

(See Appendix P 15.)

16. *Bayou Bartholomew, Louisiana and Arkansas.*—No work has heretofore been done upon this improvement. During the present season operations will be commenced at the bridge crossing of the Mississippi & Texas Railroad, and continued down stream, and will consist in the removal of all obstructions to the safe navigation of the stream.

The estimated cost of this improvement was $26,862.00.

With the appropriation asked for, for the fiscal year ending June 30, 1883, it is proposed to operate to the same end.

Amount appropriated by act approved March 3, 1881	$8,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	142 85
July 1, 1881, amount available	7,857 15
Amount (estimated) required for completion of existing project	18,862 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	10,000 00

(See Appendix P 16.)

17. *Tensas River, Louisiana.*—No work has heretofore been done upon this improvement. During the present season it is proposed to organize a party with a proper outfit and engage in the work of removing the worst obstructions to the navigation of the stream, as the small amount appropriated will not admit of more extended operations. The total estimated cost of this improvement was $23,000.

With the appropriation asked for, for the fiscal year ending June 30, 1883, it is proposed to continue the work of removing the obstructions.

Amount appropriated by act approved March 3, 1881	$3,000 00
July 1, 1881, amount available	3,000 00
Amount (estimated) required for completion of existing project	20,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	10,000 00

(See Appendix P 17.)

18. *Bayou Bœuf, Louisiana.*—No work has heretofore been done upon this improvement. For the present it is only deemed advisable to improve the navigation of this stream from the mouth to Wallace's Landing, a distance of 280 miles, by the removal of the snags, logs, &c., and work will be carried on to this end.

The estimated cost of this work was $20,020.

The appropriation asked for, for the fiscal year ending June 30, 1883, will be applied to the same end.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount available	5,000 00
Amount (estimated) required for completion of existing project	15,020 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	8,000 00

(See Appendix P 18.)

19. *Cypress Bayou, Texas and Louisiana.*—The work carried on upon this improvement has resulted in obtaining a good high-water channel through the lakes and bayou from Red River, Louisiana, to Jefferson, Texas. This was in accordance with the first project presented.

In the report of last year the officer in charge stated that should it be desirable to carry on more extended operations and to give the route to Jefferson navigable water the entire year, the plan recommended by Major Howell, to construct a dam across the lakes at Albany Point and make a cut through to Red River, would have to be carried out. The estimated cost of this work was $372,580.

The amount expended up to the close of the fiscal year ending June 30, 1880, was $89,650.96.

The amount expended during the year ending June 30, 1881, was $1,539.04.

The property was left in charge of the watchmen, and the valuable dredge belonging to the appropriation was put in repair and taken to the mouth of Red River to assist in operations at that place.

July 1, 1880, amount available	$4,349 04
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,539 04
July 1, 1881, amount available	2,810 00

(See Appendix P 19.)

20. *Water-gauges on the Mississippi River and its principal tributaries.*—Observations were continued at all the gauges, and repairs made and new gauges erected where necessary.

In conjunction with the Mississippi River Commission, bulletin boards were erected at the various gauge stations, so as to give notice to passing steamboats the recorded stage of water each morning.

The list of recorded high and low-water marks was revised, and a new one made out in accordance with the best authorities.

Tables of the yearly maximum and minimum stages of water on the Mississippi and some of its tributaries at various dates up to the year 1880, derived from authentic data, with notes explanatory of their import and inferences drawn therefrom, will be found in Appendix P 20.

July 1, 1880, amount available	$6,916 28	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$11,916 28
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		5,405 18
July 1, 1881, amount available		6,511 10
Amount that can be profitably expended in fiscal year ending June 30, 1883		5,000 00

(See Appendix P 28.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with provisions of the river and harbor act of June 14, 1880, Major Benyaurd was charged with the following, the results of which were duly transmitted to Congress at its last session:

1. *Bayou Bartholomew, Tensas River, and Bayou Macon, Louisiana.* (See Appendixes P 29, P 30, and P 31.)
2. *Current River, from Van Buren, Missouri, to its mouth in Arkansas.* (See Appendix P 32.)
3. *Harbor at Grand Gulf, Mississippi.* (See Appendix P 33.)
4. *Cache River, Arkansas, a tributary of White River.* (See Appendix P 34.)
5. *Bœuf River, North Louisiana.* (See Appendix P 18.)

The above are printed in House Ex. Doc. No. 38, Forty-sixth Congress, third session.

6. *Saint Francis, Missouri and Arkansas.* (See Appendix P 35.)
7. *Obion River, Tennessee.* (See Appendix P 36.)
8. *South Forked Deer River, Tennessee.* (See Appendix P 43.)
9. *North Forked Deer River, Tennessee.* (See Appendix P 38.)
10. *The Bay, a tributary of Saint Francis River, Arkansas.* (See Appendix P 39.)

The above are printed in House Ex. Doc. No. 62, Forty-sixth Congress, third session.

And to comply with provisions of the river and harbor act of March 3, 1881, he is charged with the following, the results of which will be duly submitted when received:

1. *Bear Creek, running into Yazoo River.*
2. *Old Town Creek, Mississippi.*
3. *Big Black River, Mississippi.*

REMOVING SNAGS, ETC., FROM THE ARKANSAS RIVER—IMPROVEMENT OF ARKANSAS RIVER BETWEEN FORT SMITH AND WICHITA AND AT PINE BLUFF, AND OF RIVERS SAINT FRANCIS, WHITE, L'ANGUILLE, FOURCHE LA FÈVE, SALINE, AND BLACK, ARKANSAS, AND CURRENT, MISSOURI AND ARKANSAS.

Officer in charge since February 1, 1881, Capt. Thomas H. Handbury, Corps of Engineers.

1. *Removing snags, &c., from Arkansas River* (in charge of Maj. Charles R. Suter, Corps of Engineers, to February 1, 1881).—This work has for its object the removal of snags, logs, and other obstructions to

the navigation of the river, more especially in the reach between Fort Smith, Ark., and its mouth. It was carried on during the last season by means of the iron snag-boat C. B. Reese, which was built especially for this purpose and commenced work for the first time early in January, 1880.

The operations of this boat during last season extended from the mouth of the river up to Webber's Falls, a distance of about 500 miles, and resulted in 963 snags pulled, weighing in the aggregate 17,347 tons, 44 drift piles removed, and 1,414 overhanging and dangerous trees cut.

It is proposed to continue the removal of these obstructions with this boat until the funds now available are exhausted. They will be sufficient for about eight months' active operations.

In addition to the funds necessary for carrying on these operations during the fiscal year ending June 30, 1883, which is $33,000, the officer in charge submits in his report an estimate of $21,000 for continuing the survey of the Arkansas River made in 1869 from Fort Gibson, Ind. Ter., to Little Rock, Ark., down to its mouth.

July 1, 1880, amount available	$35,000 00	
Amount appropriated by act approved March 3, 1881	25,000 00	
		$60,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		29,163 63
July 1, 1881, amount available		30,836 37
Amount that can be profitably expended in fiscal year ending June 30, 1883.		54,000 00

(See Appendixes Q 1 and S 1.)

2. *Arkansas River at Pine Bluff*, *Arkansas* (in charge of Maj. Charles R. Suter, Corps of Engineers, to February 1, 1881).—The plan for the improvement of the river in this locality was submitted to Congress February, 1880, to comply with requirements of the river and harbor act of March 3, 1879. The necessity for improvement here arose from the fact that the river had eroded its bank in front of the city of Pine Bluff to such an extent as to endanger valuable property. It had also so changed the direction of its channel, both above and below the city, and eroded its banks, as to form a narrow neck, which was in danger of being cut through by the action of the water. This would leave the city several miles from the river, and at the same time materially injure the general navigation of the river.

To stop these erosions and to effect a general rectification of the channel of the river in this locality was what the plan submitted proposed to accomplish. The work during the last season was carried on in accordance with this general plan, and resulted in revetting 3,900 feet of the river bank in front of the city of Pine Bluff, and 3,700 feet of the left bank in Yell's Bend, 4½ miles above. This bend is on the upper side of the narrow neck where the cut-off is threatened. In addition to this revetment 1,110 feet of wire curtain dike was put in position about 2½ miles above the city, with a view to rectification of the channel.

These works so far as completed have fulfilled expection. Erosion has ceased where the bank has been revetted. The wire curtain dike depends for its efficiency upon high-water carrying large quantities of sediment, which it checks and forms into bars. No high-water has taken place since this dike was put in place.

It is proposed, in continuation of this general plan, to expend the funds now available in further revetting the banks and rectifying the channel in this locality.

The funds appropriated by act of June 14, 1880, are the first that have been available for this work.

July 1, 1880, amount available	$25,000 00	
Amount appropriated by act approved March 3, 1881	23,000 00	
		$48,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	19,851 89	
July 1, 1881, outstanding liabilities	4,160 07	
		24,011 96
July 1, 1881, amount available		23,988 04
Amount (estimated) required for completion of existing project		52,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		52,000 00

(See Appendixes Q 2 and S 20.)

3. *Arkansas River, between Fort Smith, Arkansas, and Wichita, Kansas* (in charge of Maj. Charles R. Suter, Corps of Engineers, to February 1, 1881).—The object of this improvement is to remove snags, rocks, and other obstructions to navigation from the Arkansas River, throughout an estimated distance of 350 miles.

During last season some work was done upon the reach between Wichita and Arkansas City, Kans., a distance of about 50 miles, and preparations were made for providing the work with some suitable appliance for carrying it on during the coming season. A strong light-draught, scow-built steamboat, provided with a crane and other appliances for removing snags, wrecks, &c., is now being built for this service and nearly completed. It is proposed, during the coming season, to continue the work of removing these obstructions to navigation as long as the funds available will suffice. It is thought that this will be for about eight months' work,

The officer in charge calls special attention in his report to the necessity for continuing the survey of the Arkansas River made in 1869 from Fort Gibson, Ind. Ter., to Little Rock, Ark., up to Wichita, Kans. He renews the recommendation made by his predecessor in charge of this work, that $16,300 be appropriated for this purpose.

July 1, 1880, amount available	$16,408 25	
Amount appropriated by act approved March 3, 1881	24,000 00	
		$40,408 25
July 1, 1881, amount expended during fiscal year, exclusive of outstanding iabilities July 1, 1880		10,333 51
July 1, 1881, amount available		30,074 74
Amount that can be profitably expended in fiscal year ending June 30, 1883.		46,300 00

(See Appendixes Q 3 and S 21.)

4. *White and Saint Francis Rivers, Arkansas* (in charge of Maj. W. H. H. Benyaurd, Corps of Engineers, to February 1, 1881).—The object of this improvement is the removal of snags, wrecks, and other obstructions to the navigation of these streams. During last season a small steamer was chartered which worked in the Saint Francis River from the latter part of August until the middle of October. The work accomplished was 81 snags, 107 logs, and 71 stumps removed from the channel, and 523 trees cut from the bank.

In the White River, the United States snag-boat J. R. Meigs commenced a season's operations in September, doing thorough work from the mouth to Duvall's Bluff, the highest point reached. The boat was withdrawn the last of October, having removed during the trip 270 snags, 298 trees, and wreck of coal barge at Duvall's Bluff.

The total amount expended upon these rivers up to the close of the fiscal year ending June 30, 1880 (including cost of snag-boat), was $122,000.

With the funds now available it is proposed to continue these operations as far as they will suffice, making use of the government snag boat that has been provided for the purpose, which is capable of doing good work upon the Saint Francis River as far as Madison, and upon the White River to Jacksonport.

For work on the Saint Francis River above Madison the officer in charge estimates $16,000, of which $4,000 is to be expended in procuring proper appliances for the work. His estimate for the working expenses of the snag-boat is $20,000.

July 1, 1880, amount available	$12,000 00	
Amount appropriated by act appproved March 3, 1881	8,000 00	
		$20,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		11,821 93
July 1, 1881, amount available		8,178 07
Amount that can be profitably expended in fiscal year ending June 30, 1883		36,000 00

(See Appendixes Q 4 and P 20.)

5. *White River between Jacksonport and Buffalo Shoals* (in charge of Maj. W. H. H. Benyaurd, Corps of Engineers, to February 1, 1881).—The object of this work is the removal of snags, logs, rocks, &c., from the channel of the river, and overhanging trees from its banks; also to concentrate the water over shoals that are troublesome to navigation, and wash them away or increase the depth of water over them.

The concentration was effected by means of dams and dikes made of brush and gravel. During the year works of this character were built at Samm's Shoal, Arnold's Island Shoal, and Maguire's Shoal, resulting in each case in a material increase in the depth of water and improvement in the navigation of the river at these places.

In all, 1,065 feet of these brush and gravel dams and dikes were constructed.

A small steamer was employed for a short season removing snags, &c., working over the entire reach of the river, and removing 56 snags and stumps, and cutting 105 trees.

With the funds now available it is proposed to improve the navigation of the river at Saffold and Haggle Tooth Shoals, and to remove the most troublesome of the remaining snags, logs, and overhanging trees.

July 1, 1880, amount available	$7,213 29	
Amount appropriated by act approved March 3, 1881	8,000 00	
		$15,213 29
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		7,732 98
July 1, 1881, amount available		7,480 31
Amount that can be profitably expended in fiscal year ending June 30, 1883		20,000 00

(See Appendixes Q 5 and P 21.)

6. *White River, above Buffalo Shoals* (in charge of Maj. W. H. H. Benyaurd, Corps of Engineers, to February 1, 1881).—Navigation above Buffalo Shoals is limited to a very short season of the year. Until the appropriation of $20,000 of June 14, 1880, was made nothing had ever been done toward improving that stretch of river. An examination was made with a view to presenting a project for improvement, which when

carried out, in conjunction with improvements below Buffalo, would greatly extend the length of the navigable season.

The proposed improvement contemplates removing loose rock, blasting others, and constructing wing-dams at various shoals, removing snags, and cutting overhanging trees, so as to make it navigable during medium and high stages of water, at an estimated cost of $32,600.

No work was done during the year. The funds available will be expended during the coming season in carrying out the proposed project. It is thought that they will suffice for improving the river for 20 miles above Buffalo Shoals.

July 1, 1880, amount available	$20,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	291 67
July 1, 1881, amount available	19,708 33
Amount (estimated) required for completion of existing project	12,600 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	12,600 00

(See Appendixes Q 6 and P 22.)

7. *Saint Francis River, between Wittsburgh and Lester Landing* (in charge of Major W. H. H. Benyaurd, Corps of Engineers, to February 1, 1881).—This work is a continuation of that which has been heretofore carried on upon the Lower Saint Francis.

The proposed improvement is to cut a channel through the lake region and clear the river of obstructions by removing trees, snags, logs, &c. A party with a hired flat-boat properly equipped commenced work at Lester Landing early in August, and continued until January 15. The work was extended over the entire reach, and resulted in removing 599 stumps, 1,294 trees, 1,056 logs, and some brush from banks, and 697 trees deadened.

The appropriation being exhausted, and Congress at its last session not having made any additional for continuing this work, none can be done during the coming season.

For an estimate for continuing this work attention is invited to the estimate under the head of improving White and Saint Francis rivers, Arkansas.

July 1, 1880, amount available	$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	5,000 00

(See Appendixes Q 7 and P 23.)

8. *L'Anguille River, Arkansas* (in charge of Maj. W. H. H. Benyaurd, Corps of Engineers, to February 1, 1881).—The proposed improvement contemplates the removal of snags and similar obstructions to navigation. A small chartered steamer worked in this stream from the middle of October to the latter end of November, removing in that time 24 snags, 61 stumps, 563 trees, and 506 logs. It is proposed to continue these operations until the funds now available are exhausted. It is thought that the amount will be sufficient to put the river in good navigable condition for several years. No further appropriation is at present recommended.

July 1, 1880, amount available	$7,004 02
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,352 89
July 1, 1881, amount available	4,651 13

(See Appendixes Q 8 and P 24.)

9. *Fourche La Fève River, Arkansas* (in charge of Maj. W. H. H. Benyaurd, Corps of Engineers, to February 1, 1881).—This improvement has for its object the removal of snags, logs, overhanging trees, and other obstructions to the navigation of this stream, so as to allow the surplus products of a very fertile and growing section of country to reach a market by cheap means of transportation. A boat was chartered for this work during last season, commencing operations on the 15th of September, and continuing until the middle of December. During this time the work extended from the mouth to about 25 miles above Perryville, resulting in 53 snags removed, 3,508 trees deadened, 8,181 cuts made in clearing away logs and trees, some rocks taken from various shoals, and several small dams built at shoal places.

With the funds now available it is proposed to go over about the same ground again, pushing farther up the stream if possible, and continue the removal of obstructions of like character that are yet remaining.

July 1, 1880, amount available	$4,799 74	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$7,799 74
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		4,799 74
July 1, 1881, amount available		3,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		10,000 00

(See Appendixes Q 9 and P 25.)

10. *Saline River, Arkansas* (in charge of Maj. W. H. H. Benyaurd, Corps of Engineers, to February 1, 1881).—The object of this work is to render this stream navigable by the removal of snags, logs, and overhanging trees, and thus open an outlet to market for cotton, timber, &c., raised along its banks.

The work of last season is the first that has been done upon this stream. It was commenced in August at Turtle Bar, 6 miles below the mouth of Hurricane Creek, and carried on until about the 1st of December, when high-water caused its suspension. The party had worked down to Mount Ella. During the season 469 snags, 1,151 logs, 2,416 trees, and 9 fish-traps were removed, and many willows and other small trees cut from the banks.

During the coming season it is proposed to continue this improvement on the same general plan from Mount Ella to the mouth of the river, completing the work so far as the funds available will allow.

July 1, 1880, amount available	$7,500 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$12,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		3,862 74
July 1, 1881, amount available		8,637 26
Amount that can be profitably expended in fiscal year ending June 30, 1883		10,000 00

(See Appendixes Q 10 and P 26.)

11. *Improving Black River, Arkansas* (in charge of Maj. W. H. H. Benyaurd, Corps of Engineers, to February 1, 1881).—The object of this work is to improve the navigation of the river by removing snags and logs from the channel, overhanging trees from the banks, and increasing the depth of water over troublesome shoals.

Work upon this improvement was first commenced in August, 1880, at Pocahontas, with a chartered steamer working up stream to the Saint Louis, Iron Mountain, and Southern Railway Bridge, removing 556 snags, cutting 586 trees, and clearing much of the bank of willows, brush, and small trees.

A brush dam 850 feet long was built at Devil's Tooth Shoals, and two of 350 and 150 feet respectively at Eagle's Nest Shoals.

Little River, several bayous and sloughs were closed by constructing dams. High-water caused a suspension of work late in November. The work has resulted in a material benefit to the navigation of the river.

It is proposed during the coming season to continue these operations in furtherance of the general project, as far as the funds available will allow.

The officer in charge suggests the advisability of procuring more suitable and economical appliances for carrying on this work. He estimates that a suitable outfit could be procured for about $15,000, and that the running expenses for the next fiscal year will be about $15,000 more, making the total that could be very profitably expended $30,000.

July 1, 1880, amount available	$15,000 00	
Amount appropriated by act approved March 3, 1881	6,000 00	
		$21,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		9,895 99
July 1, 1881, amount available		11,104 01
Amount that can be profitably expended in fiscal year ending June 30, 1883		30,000 00

(See Appendixes Q 11 and P 27.)

12. *Current River, Missouri and Arkansas.*—In 1855 the State of Missouri appropriated $10,000 for the improvement of this stream, but no good seems to have been effected. In 1871 the State made another appropriation of $20,000. The river and harbor act of June 10, 1872, appropriated $5,000 for its improvement within the State of Missouri. This was expended in the removal of snags and overhanging trees and for brush wing-dams.

The same improvement is now proposed, viz, by means of wing-dams of brush and stone to concentrate the water over the shoal places and to remove snags, logs, and overhanging trees. The amount now available will be expended in furtherance of this object. Work will be commenced at the mouth and carried up stream as far as the funds will admit.

Amount appropriated by act approved March 3, 1881	$2,000 00
July 1, 1881, amount available	2,000 00
Amount (estimated) required for completion of existing project	15,365 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	15,400 00

(See Appendix Q 12.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with the provisions of the river and harbor act approved March 3, 1881, Captain Handbury is charged with the following, the results of which will be duly submitted when received:

1. *Little Red River in Arkansas.*

IMPROVEMENT OF MISSISSIPPI RIVER BETWEEN THE MOUTHS OF THE ILLINOIS AND OHIO RIVERS—IMPROVING HARBOR AND MISSISSIPPI RIVER AT ALTON—ICE HARBOR AT SAINT LOUIS, MISSOURI—IMPROVING MISSISSIPPI RIVER AT OR NEAR CAPE GIRARDEAU, MISSOURI, AND MINTON POINT, ILLINOIS—IMPROVEMENT OF OSAGE RIVER IN KANSAS AND MISSOURI.

Officer in charge, Capt. O. H. Ernst, Corps of Engineers.

1. *Mississippi River between the Illinois and Ohio Rivers.—Piasa Island.*—A project for the improvement of the river in this vicinity was prepared; but before the works could be begun, the funds available were withdrawn in consequence of the proviso attached to the appropriation of March 3, 1881, and reappropriated for the purposes of the improvement of the river at Alton.

No other work was done between the Illinois and Missouri Rivers during the year, and none is contemplated under the general appropriation during the comming year.

Cahokia Chute.—The present project for the improvement of this locality was adopted in 1876, the object being to stop the inroads of the river into the Illinois bank, and the consequent deterioration of the navigation. This object was successfully accomplished last year; the amount expended up to June 30, 1880, being $116,088.60. To finally complete the improvement of the navigation in this vicinity it will be necessary to shut off all the water from Cahokia Chute.

No work was done here during the year, and none is contemplated during the coming year.

Horsetail Bar.—The present project for the improvement of this locality was adopted in 1873 and modified in 1879, the object being to afford a channel not less than 8 feet deep. The natural channel was often not more than 4 feet deep at the shoalest part. The amount expended during the year was $116,078.53. The total amount expended to June 30, 1881, is $511,529.44, and has resulted in securing a channel in which it is expected that the depth will not be less than 7 feet during the coming year. A balance of $33,921.47 remains available from the appropriation of June 14, 1880, with which it is expected to practically complete the work, though it will be the object of care for an uncertain number of years.

Twin Hollow and Widow Beard's.—A project for the improvement of these two adjoining localities has been adopted, the object being to afford a channel not less than 8 feet deep. The natural channel has sometimes been not more than 4 feet deep in the shoalest part. The works have not yet been begun. An allotment of $115,000 has been made from the appropriation of March 3, 1881.

Kaskaskia Bend.—The present project for the protection of this bank was adopted in 1876 and modified in 1880, the object being to stop the caving in a bend 23,000 feet long. The amount expended during the year was $12,326.34. The total amount expended to June 30, 1881, is $66,465.62, which was applied to the direct revetment of about 6,000 feet of bank and to work designed to change the direction of attack of the river. The work was this spring almost wholly, if not wholly, destroyed by the action of ice and flood. The results are therefore practically nothing. The officer in charge in his annual report sets forth at length the reason why this work should not be resumed in the interest of navigation; and he points out some objections to resuming it for the protection of local interests. Should it be deemed proper to resume it, a large appropriation, not less than $100,000, should be made available before the work is begun. A radical change in the course of the river is required, the final cost of which, if caused by artificial means, cannot now be estimated. Rapid changes are going on in the vicinity, and it would seem proper to allow these to continue until the stream has worked itself into better shape than the present one. No appropriation is recommended. The sum of $5,697.25 allotted to this work by the river and harbor act of June 14, 1880, remains unexpended. As this sum alone cannot be used here to any useful purpose, it is recommended that provision be made in the next river and harbor bill for its application to the general improvement.

Protection between Dickey Island and the mouth of the Ohio.—The present project for the protection of this bank was adopted in 1876, the object being to stop the caving in a bend 11,500 feet long. The amount expended during the year was $6,517.23. The total amount expended to June 30, 1881, is $119,868.66, and has resulted in the protection of 10,700 feet of bank previously unprotected and in the repair and strengthening of the works previously built by the Cairo Land Company, covering a length of 3,500 feet more, making in all 14,200 feet of bank. To entirely complete this part of the protection a small amount of work will be required this year.

Estimate.—The appropriation of $1,000,000 asked for is to be applied to completing the works now progressing and to continuing those to be begun this year at Twin Hollow, Widow Beard's Island, and between the mouth of the Meramec and Rush Towhead, and to beginning new works below the latter place.

The programme is to make the improvement continuous, working down stream from Saint Louis, by reclaiming land and building up new banks, thus reducing the width of the river to the uniform width of about 2,500 feet. It is proposed by this means to secure a minimum depth of 8 feet. The depth is now liable to become as little as 4 feet in some places and less than 8 feet in every place where the width is greater than 2,500 feet. Caving banks are to be protected. From the changeable nature of the stream, it is not practicable to give in advance the exact localities where work will be required. The appropriation of this sum is recommended.

July 1, 1880, amount available	$283,338 57	
Amount appropriated by act approved March 3, 1881	600,000 00	
		$883,338 57
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	231,395 81	
Amount reappropriated by act March 3, 1881	33,354 70	
July 1, 1881, outstanding liabilities	1,778 71	
		266,529 22
July 1, 1881, amount available		616,809 35
Amount (estimated) required for completion of existing project*		5,539,420 32
Amount that can be profitably expended in fiscal year ending June 30, 1883		1,000,000 00

(See Appendix R 1.)

2. *Improving harbor and Mississippi River at Alton.*—This work, for which provision was made in the river and harbor act of March 3, 1881, has not yet been begun. The project adopted has for its object the removal of the shoal now existing in front of the Alton landing.

The officer in charge submits an estimate of $86,675.30 as the amount that can be profitably expended upon this work during the year ending June 30, 1883. The appropriation of this amount is recommended. It is proposed with it to complete the first branch, 4,800 feet long, of the proposed dike.

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* NOTE.—Amount reappropriated by act of March 3, 1881, to be applied to harbor and Mississippi River at Alton and amounts expended at Kaskaskia Bend are added to estimate of last year.

Amount appropriated by act approved March 3, 1881	$33,354 70
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	30 00
July 1, 1881, amount available	33,324 70
Amount (estimated) required for completion of existing project	86,675 30
Amount that can be profitably expended in fiscal year ending June 30, 1883.	86,700 00

(See Appendix R 2.)

3. *Ice-harbor at Saint Louis, Missouri.*—A project for the construction of this work was prepared in compliance with the provisions of the river and harbor act of June 14, 1880.

It having become evident that the steamboatmen of Saint Louis regarded the construction of the ice-harbor with great indifference, the beginning of the work has been postponed.

July 1, 1880, amount available	$50,000 00
Amount appropriated by act approved March 3, 1881	10,000 00
July 1, 1881, amount available	60,000 00
Amount (estimated) required for completion of existing project	122,000 00

(See Appendix R 3.)

4. *Improving Mississippi River at or near Cape Girardeau, Missouri, and Minton Point, Illinois.*—A project for the improvement of this locality was prepared and adopted, but active operations were limited to the preparation of plant. The amount expended was $4,820.16.

The officer in charge submits an estimate of $60,170.16, the appropriation of which is recommended for the year ending June 30, 1883. With this sum it is proposed to remove the bar in front of Cape Girardeau landing and to provide an 8-foot channel between that place and Minton Point.

July 1, 1880, amount available	$20,000 00	
Amount appropriated by act of March 3, 1881	10,000 00	
		$30,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		4,820 16
July 1, 1881, amount available		25,179 84
Amount (estimated) required for completion of existing project		60,170 16
Amount that can be profitably expended in fiscal year ending June 30, 1883.		60,200 00

(See Appendix R 4.)

5. *Osage River, Kansas and Missouri.*—The present system of improvement was begun in 1871 and modified in 1872, the object being to afford a channel of navigable width not less than 2 feet deep at the lowest stage. The natural channel is frequently not more than 6 inches deep at many of the shoals.

The amount expended during the year was $18,918.73. The total amount expended to June 30, 1881, is $158,173.61, and has resulted in increasing the depth to at least 2 feet over 19 shoals, and removing overhanging trees and snags from six others, and in giving a continuous

2-foot navigation to Tuscumbia, 60 miles from the mouth, with the exception of four places where the obstacles have been renewed.

The system is believed to be inapplicable to the portion of the river above Tuscumbia. The great expense of the alternative system, a lock and dam improvement, would hardly seem to be justified at this time.

No appropriation for the year ending June 30, 1883, is asked for.

July 1, 1880, amount available	$30,794 99	
Miscellaneous receipts	32 62	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$50,827 61
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		18,918 73
July 1, 1881, amount available		31,908 88

(See Appendix R 5.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with the provisions of the river and harbor act of June 14, 1880, Captain Ernst was charged with and has completed the following examinations and surveys:

1. *Mississippi River at Saint Genevieve, Missouri.* (See Appendix R 6.)
2. *Meramec River, Missouri, from its mouth to the point opposite Meramec Iron Works, Missouri.* (See Appendix R 7.)

Transmitted to Congress and printed as Senate Ex. Doc. 44, Forty-sixth Congress, third session.

And to comply with the provisions of the river and harbor act of March 3, 1881, he has been charged with and is now engaged upon the following survey, the result of which will be duly submitted when received:

Fish Bend, near Fort Chartres, in the Mississippi River.

REMOVING SNAGS AND WRECKS FROM THE MISSISSIPPI AND MISSOURI RIVERS—SURVEYS AND IMPROVEMENTS AT VARIOUS POINTS ON MISSOURI RIVER—SURVEY OF MISSOURI RIVER FROM ITS MOUTH TO SIOUX CITY.

Officer in charge, Maj. Charles R. Suter, Corps of Engineers.

1. *Removing snags and wrecks from the Mississippi and Missouri rivers—Mississippi River.*—During the past season the snag-boats worked on this stream from the mouth of the Missouri to the head of Deadman's Bend, a distance of 1,000 miles.

The new snag-boat, in process of construction at date of last report, has been completed and set to work. The officer in charge renews his recommendation that the remaining wooden snag-boat be thoroughly repaired and fitted up for wrecking purposes. An estimate for the purpose is submitted.

During the present fiscal year it is proposed to devote twenty months of snag-boat work to this improvement.

ESTIMATE.

For repairing one wooden snag-boat and fitting it up for wrecking purposes	$50,000 00
For working expenses of three boats, ten months each, at $4,000 per month	120,000 00
Total	170,000 00

July 1, 1880, amount available	$101,404 90	
Amount received (clerical error in account rendered)	27 00	
Amount appropriated by act approved March 3, 1881	80,000 00	
		$181,431 90
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		102,308 43
July 1, 1881, amount available		79,123 47
Amount that can be profitably expended in fiscal year ending June 30, 1883		170,000 00

Missouri River.—During the past season the snag-boats worked on this river from the mouth to Kansas City, Mo., a distance of 375 miles.

The present appropriation will be devoted to the construction of an iron-hulled snag-boat, to carry the machinery of one of the old boats. An estimate for completing this work is submitted. The officer in charge recommends the construction of a small light-draught snag-boat for service above Omaha, where work is greatly needed, but cannot be satisfactorily accomplished with any of the present fleet. An estimate therefor is submitted:

ESTIMATE.

For completing the construction of a snag-boat, now authorized	$25,000 00
For building a light-draught snag-boat	80,000 00
For operating three boats, nine months each, at $4,000 per month	108,000 00
Total	213,000 00

July 1, 1880, amount available	$66,041 48	
Amount appropriated by act approved March 3, 1881	80,000 00	
		$146,041 48
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		66,041 48
July 1, 1881, amount available		80,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		213,000 00

(See Appendix S 1.)

2. *Missouri River at Saint Charles, Missouri.*—Work was inaugurated here in the spring, and is still in progress. Permeable dikes, composed of wire netting, supported by buoys, piles, or tripods, are being constructed, the object being to contract and define the channel. This work, together with revetment, will be pushed during the current season as far as the available funds will allow. The estimate for this improvement has been revised and extended.

July 1, 1880, amount available	$25,000 00	
Amount received from sale of fuel to officers	73 12	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$40,073 12
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		24 191 81
July 1, 1881, amount available		15,881 31
Amount (estimated) required for completion of existing project		250,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		60,000 00

(See Appendix S 2.)

3. *Missouri River at Cedar City, Missouri.*—Work here was begun in the spring of 1881, and consisted mainly in silting up Cedar City Bend by means of a permeable dike of wire screens, supported on tripods. This work, being done at a favorable season, has been very successful, and the working force will soon begin operations in Murray's Bend, above

Cedar City, in further pursuance of the approved plan. This work will be pushed during the present season as far as the funds available will allow. The estimate for this improvement has been revised and extended.

July 1, 1880, amount available	$15.413 97	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$30,413 97
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		13,576 78
July 1, 1881, amount available		16,837 19
Amount (estimated) required for completion of existing project		170,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		60,000 00

(See Appendix S 3.)

4. *Missouri River at Glasgow, Missouri.*—During the past season work was confined to revetting the right bank of the river in the bend above Glasgow; 5,630 feet of bank were protected, and the work has stood very well. Much delay was experienced in getting to work this year, but operations are now in progress and will be pushed as far as the available funds will allow.

July 1, 1880, amount available	$21,009 82	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$41,009 82
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		25,746 39
July 1, 1881, amount available		15,263 43
Amount (estimated) required for the completion of existing project		78,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		78,000 00

(See Appendix S 4.)

5. *Missouri River at Lexington, Missouri.*—Work was begun at this point last fall, and about 5,000 feet of revetment put in on the left bank opposite Lexington. Owing to the very early setting in of winter this work could not be completed properly, and it was lost during the violent floods which prevailed in the spring. Work is again in progress, and will be carried on as far as the funds available will allow. The estimate for this work has been revised and extended.

July 1, 1880, amount available	$15,000 00	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$25,000 00
July 1, 1881, amount expended during the fiscal year, exclusive of outstanding liabilities July 1, 1880		10,616 30
July 1, 1881, amount available		14,383 70
Amount (estimated) required for completion of existing project		100,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		50,000 00

(See Appendix S 5.)

6. *Missouri River at Kansas City, Missouri.*—Preparations were made at this point to push the work vigorously during the spring, but this was found impossible owing to the prevailing floods. The most important of the works already in have stood very well, but the great changes brought about by the floods render their immediate extension imperative. Work will be pushed as far as funds will allow during the present season. The estimate for this improvement has been revised and extended.

July 1, 1880, amount available	$25,156 96	
Amount appropriated by act approved March 3, 1881	20,000.00	
		$45,156 96
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		21,244 35
July 1, 1881, amount available		23,912 61
Amount (estimated) required for completion of existing project		220,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		100,000 00

(See Appendix S 6.)

7. *Missouri River at Fort Leavenworth, Kansas.*—Some repairs of the old work were found necessary last fall and were carried out. Nothing was done during the spring owing to the unprecedented floods, which did great damage to the work already in. During the present season it is hoped to make the necessary repairs and take measures to regulate the river in this vicinity. The amount available is, however, very small in comparison with the work needed. A revision and extension of the estimates has been found necessary.

July 1, 1880, amount available	$8,451 35	
Amount appropriated by act approved March 3, 1881	8,000 00	
		$16,451 35
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		5,171 78
July 1, 1881, amount available		11,279 57
Amount (estimatd) required for completion of existing project		90,000 00
Amount that can be frofitably expended in fiscal year ending June 30, 1883		50,000 00

(See Appendix S 7.)

8. *Missouri River at Atchison, Kansas.*—No work was done during the past season, but will be pushed during the present year as far as the funds will allow. Many important changes were brought about by the late floods, and although the work already in still stands, considerable extension is needed to accomplish the object of the improvement. The estimates have, therefore, been revised and extended.

July 1, 1880, amount available	$20,004 42	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$40,004 42
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		17,007 28
July 1, amount available		22,997 14
Amount (estimated) required for completion of existing project		125,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		60,000 00

(See Appendix S 8.)

9. *Missouri River at and near Saint Joseph, Missouri.*—But little work was done here during the past year, the violent spring floods having rendered the operations proposed impossible. Work is now in progress, however, and will be prosecuted as far as possible with the funds available. The works already constructed have stood satisfactorily, the damage by ice and floods being small and easily repaired. The estimate for this improvement has been revised and extended.

July 1, 1880, amount available	$21,155 61	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$41,155 61
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		13,232 34
July 1, 1881, amount available		27,923 27

Amount (estimated) required for completion of existing project		$223,000 00
Amount that can be profitably expended in fiscal year ending June 30. 1883.		90,000 00

(See Appendix S 9.)

10. *Missouri River at Brownville, Nebraska.*—Some preliminary work was done at this place during the winter, and it was expected to do considerable work in the spring. This, however, was rendered impossible by the general inundation accompanying the floods of that season. Work will be prosecuted during the current year to the extent of the funds available. The approximate estimates heretofore submitted have been revised.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$20,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		11,254 23
July 1, 1881, amount available		8,745 77
Amount (estimated) required for completion of existing project		353,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		80,000 00

(See Appendix S 10.)

11. *Missouri River at Eastport, Iowa, and at Nebraska City, Nebraska.*—But little was done at this locality during the past year, it being deemed advisable to defer work till spring, when it could be done to best advantage. This intention was frustrated by the extreme violence of the floods which prevailed at that season, and, in addition, almost all the work accomplished in previous seasons was swept away. This misfortune was due solely to the incomplete state in which it had necessarily been left by the small appropriations under which the work had been carried on. The improvement of this very troublesome piece of river will be impossible unless funds are made available in larger amounts. A new estimate for carrying out this work is submitted herewith.

July 1, 1880, amount available	$14,618 20	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$34,618 20
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		16,136 16
July 1, 1881, amount available		18,482 04
Amount (estimated) required for completion of existing project		500,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		100,000 00

(See Appendix S 11.)

12. *Missouri River at Plattsmouth, Nebraska.*—It was expected to begin work at this point during the spring of 1881, but the excessive floods prevented this, and the work proposed is but just beginning. It will be prosecuted during the present season as far as practicable. The estimate for this improvement has been revised.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$20,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		4,583 85
July 1, 1881, amount available		15,416 15
Amount (estimated) required for completion of existing project		214,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883..		70,000 00

(See Appendix S 12.)

13. *Missouri River at Council Bluffs, Iowa, and at Omaha, Nebraska.*—The work done here during the past season consisted mainly in repairs to old work. The works of channel contraction and regulation which formed the programme of the spring's operations were mostly stopped by the excessive floods, but will be carried on as far as practicable during the present season. The works already put in were somewhat damaged by the ice, but not seriously. The impossibility of carrying this work to completion with the small appropriations heretofore made has rendered a revision and extension of the estimates necessary.

July 1, 1880, amount available	$21,344 51	
Amount appropriated by act approved March 3, 1881	30,000 00	
		$51,344 51
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		13,720 13
July 1, 1881, amount available		37,624 38
Amount (estimated) required for completion of existing project		260,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		100,000 00

(See Appendix S 13.)

14. *Missouri River at Sioux City, Iowa.*—It was proposed last year to expend the current appropriation in extending the work already done at this place, mainly, in works of channel contraction and regulation. This work, which should have been done during the spring of 1881, was entirely stopped by the violence of the spring floods. Such money as remains of the old appropriation and the new one made for the current year will be expended in this work during the present season. The work put in here in previous seasons stands well, and will need but trifling repairs. Estimates are submitted for extending the work over a greater length of river, which is deemed absolutely necessary to secure anything like a stable regimen in this neighborhood.

July 1, 1880, amount available	$8,401 34	
Amount received sales of fuel to officers	34 87	
Amount allotted from appropriation for survey of Missouri River from its mouth to Sioux City, Iowa, &c., act approved June 14, 1880	4,000 00	
Amount appropriated by act approved March 3, 1881	7,000 00	
		$19,436 21
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		8,359 00
July 1, 1881, amount available		11,077 21
Amount (estimated) required for completion of existing project		560,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		100,000 00

(See Appendix S 14.)

15. *Missouri River at Vermillion, Dakota.*—It was proposed last year to expend the current appropriation in regulating the channel in the immediate vicinity of the town of Vermillion and in protecting the banks so to as prevent a cut-off then threatening. It was intended that the work should be done during the spring of 1881, and all preparations were made with that end in view. The spring movement of the ice was accompanied by an unprecedented flood which inundated the whole valley. The cut-off above alluded to took place, and such extensive changes were made that a complete revision of the plans was necessary, and the necessity of a considerable extension of the work became evident. The accompanying estimate is for the new project, and the appropriations now available will be expended in prosecuting it as far as possible.

July 1, 1880, amount available	$10,002 15	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$25,002 15
July 1, 1881, amount expended during the fiscal year, exclusive of outstanding liabilities July 1, 1880		5,417 01
July 1, 1881, amount available		19,585 14
Amount (estimated) required for completion of existing project		113,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		70,000 00

(See Appendix S 15.)

16. *Missiouri River, between Kansas City and the mouth.*—This appropriation will be devoted to snagging, of which eight months' work will be accomplished. The accompanying estimate of $375,000 refers to the general improvement of that portion of the river herein referred to under the general plan already submitted. (See House Ex. Doc. No. 92, Forty-sixth Congress, third session, and also Appendix S16.)

Amount appropriated by act approved March 3, 1881	$35,000 00
July 1, 1881, amount available	35,000 00
Amount (estimated) required for completion of existing project	3,750,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	800,000 00

(See Appendix S16.)

17. *Preliminary report upon the general improvement of the navigation of the Missouri River.* (See Appendix S 17.)

18. *Survey of the Missouri River, from its mouth to Sioux City, Iowa, and to Fort Benton, Montana.*—During the past year the maps of the survey of Sioux City, Iowa, were about completed, and their reduction to a scale suitable for publication progressed fairly. Work in the field was much delayed by the early winter and the spring floods. The line of check levels is nearly completed and all other field work has been closed up.

During the present season it is proposed to extend the survey above Sioux City as far as possible with the funds available, and to publish the maps of the survey already made. Estimate for the completion of the work to Fort Benton is submitted herewith.

A preliminary report on the general improvement of the river, with plan and estimates for the work proposed, from Sioux City to the mouth, was submitted during the year and printed as House Ex. Doc. No. 92, Forty-sixth Congress, third session.

July 1, 1880, amount available	$30,151 82	
Amount appropriated by act approved March 3, 1881,	30,000 00	
		$60,151 82
Amount allotted for protecting work done on the Missouri River at or near Sioux City, Iowa (act approved June 14, 1880)	4,000 00	
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880,	22,360 27	
		26,360 27
July 1, 1881, amount available,		33,791 55
Amount (estimated) required for completion of existing project		105,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		50,000 00

(See Appendix S 18.)

19. *Gasconade River, Missouri.*—Work was begun on the improvement of this stream October 22, 1880, and was continued to December 31, 1880, when the severe weather which had set in forced the party from the field. Such portions of the river as were worked over were quite thoroughly cleared of snags and the results were satisfactory.

As soon as the river reaches a lower stage, work will be resumed and pushed to the extent of the funds available.

July 1, 1880, amount available	$5,000 00	
Amount received from sales of fuel to officers	39 37	
Amount appropriated by act approved March 3, 1881	10,000	
		$15,039 37
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		3,969 87
July 1, 1881, amount available		11,069 50
Amount (estimated) required for completion of existing project		35,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		35,000 00

(Appendix S 19.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with the provisions of the river and harbor act of June 14, 1880, Major Suter was charged with and has completed the following surveys:

1. *Missouri River, at Boonville, Missouri.* (See Appendix S 22.)
2. *Missouri River, at Yankton, Dakota.* (See Appendix S 23.)
3. *Missouri River, at Niobrara, Nebraska.* (See Appendix S 24.)
4. *Missouri River, from Tuque Creek to* 1 *mile west of Charrette Creek, Warren County, Missouri.* (See Appendix S 25.)

The above were printed as House Ex Doc. No. 89, Forty-sixth Congress, third session.

5. *Mouth of Grand River and Missouri River, at Brunswick, with reference to boat-landing at Brunswick, Missouri.* (See Appendix S 26.)

And to comply with the provisions of the river and harbor act of March 3, 1881, he has been charged with and is engaged upon the following, the results of which will be duly submitted when received:

1. *Missouri River, at or near Arrow Rock.*
2. *For survey of Nishuabotana, from Hamburg, Iowa, to its junction with the Missouri.*

IMPROVEMENT OF MISSOURI RIVER, ABOVE MOUTH OF YELLOWSTONE—IMPROVEMENT OF YELLOWSTONE RIVER.

Officer in charge, Capt. Edward Maguire, Corps of Engineers.

1. *Missouri River, above mouth of Yellowstone, Montana.*—The work of improvement was carried on in two distinct sections of the river, viz, above the Great Falls and below Benton.

The work above the Falls consisted in building two dams at Bear's Teeth Shoal; in clearing a channel 70 feet wide and 2½ feet deep by the removal of rock from Bear's Teeth Rapids; in clearing a channel 100 feet wide by the removal of rock at Lone Pine or Half Breed Rapids.

The work below Benton consisted in building a dam at McGarry's Bar 505 feet long; in building a new dam at Dauphin's Rapids 703 feet long; in clearing a channel 100 feet wide and 5,100 feet long by the removal of rock at Little Dog Rapids; in removing rock near the head of Dauphin's Rapids; in clearing a channel 100 feet wide and 2,000 feet long by the removal of rock at Bear's Rapids; in building at Snake Point a dam 615 feet long, and in blasting out rock in the channel at the same point.

The survey of the river was continued from Dauphin's to Gallatin Rapids, and a survey made of Snake Point.

The work during the present season will be confined to that portion of the river below Benton. A dam will be built near Trover's Point; bowlders will be removed from Buffalo Shoals; the works at Grand Island will be repaired, strengthened, and extended; Gallatin Rapids will be cleared, and such other work of "general clearing of the channel" as can be accomplished. The work already done has benefited the navigation of the river. There were 23 trips made above Cow Island after August 1 last season, while only one was made in 1877.

July 1, 1880, amount available	$46,551 88	
Amount appropriated by act approved March 3, 1881	40,000 00	
		$86,551 88
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	34,196 65	
July 1, 1881, outstanding liabilities	5,841 11	
		40,037 76
July 1, 1881, amount available		46,514 12
Amount that can be profitably expended in fiscal year ending June 30, 1883.		150,000 00

(See Appendix T 1.)

2. *Yellowstone River, Montana and Dakota.*—The work of improvement was carried on by two parties. One operated at Buffalo Rapids completing the work at that place. During the last two seasons a channel 8,800 feet long, from 100 to 180 feet wide, and from 3 to 5 feet in depth was cleared. The slope has been materially reduced, and steamboats now seldom use a line.

The second party worked at Baker's and Wolf Rapids. At the former place the channel used by the steamboats was cleared to a depth of 3 feet and for a width of from 120 to 180 feet. At Wolf Rapids a channel 300 feet long, 100 feet wide, and 3 feet deep was cleared.

At all of these points the work done has materially benefited navigation. A large quantity of rock was blown down into deep water. The nature of the material of which the ledges were formed necessitated a great deal of drilling and much blasting.

The work during the present season will consist in building dams just above Buffalo Rapids; near Custer Creek; near De Russy's Rapids; near the town of Glendive and at Beef Slough, and in removing rock at a point about 6 miles below Buffalo Rapids, at a point about 14 miles below Buffalo Rapids, and at Dead Man's Rapids, and in completing the work at Baker's and Wolf Rapids.

July 1, 1880, amount available	$29,423 13	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$49,423 13
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	16,937 55	
July 1, 1881, outstanding liabilities	4,829 70	
		21,767 25
July 1, 1881, amount available		27,655 88
Amount that can be profitably expended in fiscal year ending June 30, 1883..		100,000 00

(See Appendix T 2.)

IMPROVEMENT OF THE NAVIGATION OF THE MISSISSIPPI RIVER BETWEEN SAINT PAUL AND THE MOUTH OF THE ILLINOIS, INCLUDING IMPROVEMENTS AT SPECIAL LOCALITIES BETWEEN THOSE POINTS—IMPROVEMENT OF GALENA RIVER AND HARBOR, ILLINOIS —IMPROVEMENT OF CUIVRE RIVER, MISSOURI.

Officer in charge, Capt. A. Mackenzie, Corps of Engineers.

1. *Upper Mississippi River, operations of snag-boat, &c.*—During the

year the United States snag-boat General Barnard was employed as heretofore in removing snags and other obstructions, and in making surveys for future improvements.

It is proposed with the funds now available to continue operations during the working season of 1881 in the same manner as in former years, and to build in the winter a light-draught steamer for use in low-water and for making the necessary repairs to dams and shore protections already constructed.

The officer in charge submits an estimate of $30,000 for running the boats and making repairs during the fiscal year ending June 30, 1883, which amount cannot be materially reduced without seriously impairing their usefulness.

July 1, 1880, amount available	$11,840 52	
Amount appropriated by act approved March 3, 1881	25,000 00	
		$36,840 52
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		8,493 93
July 1, 1881, amount available		28,346 59
Amount that can be profitably expended in fiscal year ending June 30, 1883		30,000 00

(See Appendix U 1.)

2. *Mississippi River from Saint Paul to the Des Moines Rapids.*—During the year the work of improvement was carried on in the construction of brush and stone dams and shore protections at Nininger Slough, Red-wing, Wabasha, Beef Slough, Pomme de Terre Slough, Rollingstone, Winona, Cassville Slough, Guttenberg, Rush Chute, and Shokokon Slough, in dredging chiseled rock at Horse Island, and in dredging sand, clay, and bowlders at Keithsburg. It is proposed to employ the funds now available in continuing improvements between Saint Paul and Hastings, at Reed's Landing between Chimney Rock and Winona, in vicinity of La Crosse, at Cassville Slough, Rush Chute, and Shokokon Slough, and in the completion of dredging at Keithsburg.

The officer in charge recommends an appropriation of $750,000 for continuing the improvement of the Mississippi River between Saint Paul and Des Moines Rapids, for the fiscal year ending June 30, 1883.

The work of former years has been productive of the best results, and the government now being provided with 4 complete equipments of its own in the way of steamboats, barges, &c., will be able to expend to great advantage and very economically the amount asked for.

July 1, 1880, amount available	$173,600 05	
Received from sale of fuel	18 66	
Amount appropriated by act approved March 3, 1881	200,000 00	
		$373,618 71
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	128,755 12	
July 1, 1881, outstanding liabilities	754 91	
		129,510 03
July 1, 1881, amount available		244,108 68
Amount that can be profitably expended in fiscal year ending June 30, 1883		750,000 00

(See Appendix U 2.)

3. *Mississippi River from Des Moines Rapids to mouth of Illinois River.*—During the year works of improvement by means of brush and stone dams and shore protections were carried on at Gilbert's Island, Denmark Island, Gregory's Landing, and Westport Chute.

It is proposed with the funds now available to continue work at Gilbert's Island and Denmark Island, to raise and strengthen the dams at Canton and Smoot's Chute, and to inaugurate work between Canton and La Grange, and at such other points as the coming low-water may show to be most in need of improvement.

The officer in charge recommends an appropriation of $500,000 for continuing the improvement of the Mississippi River between Des Moines Rapids and the mouth of Illinois River for the fiscal year ending June 30, 1883. The work of former years has been productive of good results, and the government, which is now provided with a complete equipment of its own, will be able to expend to great advantage the amount asked for.

July 1, 1880, amount available	$102,545 48	
Received from sale of fuel	70 14	
Amount appropriated by act approved March 3, 1881	175,000 00	
		$277,615 62
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	92,632 38	
July 1, 1881, outstanding liabilities	765 27	
		93,397 65
July 1, 1881, amount available		184,217 97
Amount that can be profitably expended in fiscal year ending June 30, 1883		500,000 00

(See Appendix U 3.)

4. *Removing sand-bar in Mississippi River opposite Guttenberg, Iowa.*—The work of the past season consisted in the commencement of a dam of brush and stone to close Swift Slough, in the expectation that the contraction of water-way would cause sufficient scour on the bar in front of the town to remedy the present difficulties. The sum now available being sufficient for the completion of this work, no further appropriation is asked for.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount available	5,000 00

(See Appendix U 4.)

5. *Removal of bar in Mississippi River opposite Dubuque, Iowa.*—No work was done during the past year at this locality. The work heretofore accomplished consisted in the removal by dredging of a large portion of the bar in front of the Dubuque Wharf, thereby affording ample depth of water at all stages of the river. It was expected that auxiliary spur-dams would be needed, extending from the Illinois shore, to keep the current on the Dubuque side, but as yet the bar shows no tendency to reform, and until such tendency is manifest, it is proposed to do no further work. As the balance now available will be sufficient for the fiscal year ending June 30, 1883, no appropriation is asked for, for that period.

July 1, 1880, amount available	$7,000 63	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$12,000 63
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		23 52
July 1, 1881, amount available		11,977 11
Amount (estimated) required for completion of existing project		9,770 03

(See Appendix U 5.)

6. *Rock Island Rapids, Mississippi River.*—During the past year surveys of the various cuts through the rocky chains were made, with a

view to determining the location of patches of rock or bowlders that still remain in the channel. Experimental buoys, for the benefit of navigators, were placed at many points, and a small steam-launch was built for the purpose of caring for them in the future and replacing them when disturbed. As the funds now available will be sufficient to complete the original project, no further appropriation is asked for.

July 1, 1880, amount available	$9,434 21	
Amount appropriated by act approved March 3, 1881	8,000 00	
		$17,434 21
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		6,223 65
July 1, 1881, amount available		11,210 56

(See Appendix U 6.)

7. *Harbor at Rock Island, Illinois.*—During the past year considerable dredging was done along the steamboat landings, and several cuts were made through the bar for the purpose of turning the current towards the Illinois shore and keeping the wharf free from deposits. Owing to scarcity of dredges, it will only be possible during the present year to perform a small amount of dredging at the wharf.

The funds now available being sufficient for the fiscal year ending June 30, 1883, no appropriation is asked for.

July 1, 1880, amount available	$6,000 00	
Amount appropriated by act approved March 3, 1881	6,000 00	
		$12,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,255 15	
July 1, 1881, outstanding liabilities	385 23	
		4,640 38
July 1, 1881, amount available		7,359 62
Amount (estimated) required for completion of existing project		14,759 15

(See Appendix U 7.)

8. *Mississippi River at Andalusia, Illinois.*—The object of this improvement is, by the construction of several dams and shore protections, to open up and maintain a good landing for steamboats at all stages of the river at this point. No work has yet been done. The amount asked for, $12,000, is to be applied to the completion of the improvement.

Amount appropriated by act approved March 3, 1881	$6,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	39 55
July 1, 1881, amount available	5,960 45
Amount (estimated) required for completion of existing project	12,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	12,000 00

(See Appendix U 8.)

9. *Harbor at Muscatine, Iowa.*—Dredging along the wharf and in front of the city was continued during the past year, and the funds available will be applied in the same manner during present season. Until the main channel of the river changes from the Illinois to the Iowa side, as it now shows indications of doing, so that the Illinois chute may be closed up, occasional dredging will be needed in Muscatine Harbor, as the dredged areas fill up considerably from year to year.

The officer in charge estimates that $5,000 can be profitably spent during fiscal year ending June 30, 1883.

July 1, 1880, amount available	$7,500 00	
Amount appropriated by act approved March 3, 1881	2,500 00	
		$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		5,643 51
July 1, 1881, amount available		4,356 49
Amount (estimated) required for completion of existing project		1,750 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		5,000 00

(See Appendix U 9.)

10. *Rush Chute and Harbor at Burlington, Iowa.*—During the past year Rush Chute Dam was raised to a height of 4 feet above low-water and considerably strengthened. Considerable shore protection was laid on the west side of Rush Island and on the east side of the little island in the chute, and large quantities of material have been collected to be used in continuing the work. As this work will hereafter be carried on under appropriation for "improving Mississippi River from Saint Paul to Des Moines Rapids," no further special appropriation is asked for.

July 1, 1880, amount available	$12,651 71
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	12,651 71

(See Appendix U 10.)

11. *Harbor at Fort Madison, Iowa.*—No work was done during past year, there being no funds available. The project for work of the present year has not been presented, it being deemed advisable to await the subsidence of high-water before making the necessary examinations. To complete the original project the sum of $6,086.87 is asked for for the fiscal year ending June 30, 1883.

Amount appropriated by act approved March 3, 1881	$2,500 00
July 1, 1881, amount available	2,500 00
Amount (estimated) required for completion of existing project	6,086 87
Amount that can be profitably expended in fiscal year ending June 30, 1883.	6,100 00

(See Appendix U 11.)

12. *Mississippi River near Alexandria, Missouri.*—The project for this work proposes to deepen to 5 feet the water on the bar known as the Warsaw Crossing by the construction of several wing-dams. During the past year a dam was built from the Missouri shore a short distance above Alexandria, extending 910 feet into the river and raised to an elevation of 4 feet at low-water. A second dam was begun 2,000 feet above, and it is proposed with the funds now available to complete this dam during the present season. To complete the improvement under the original project the sum of $14,945 is asked for for the fiscal year ending June 30, 1883.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	6,000 00	
		$16,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		10,035 85
July 1, 1881, amount available		5,964 15
Amount (estimated) required for completion of existing project		14,945 75
Amount that can be profitably expended in fiscal year ending June 30, 1883.		15,000 00

(See Appendix U 12.)

13. *Improvement of navigation of Mississippi River at Quincy, Illinois.*—The original project contemplated the improvement of the bad bar in the river in front of the city and the construction of an ice harbor by dredg-

ing out the accumulated deposits in Quincy Bay. The river bar was thoroughly improved in 1879 by the construction of a wing-dam from the Missouri shore. During the past year dredging was continued in Quincy Bay, and a dam was begun to close Squaw Chute and thereby prevent the washing of sand from the main river through the chute into the lower end of the bay. With the funds available dredging will be continued in the bay, and it is also proposed to do some special dredging and piling at the lower end of the bay at the site of the government depot, in order to prepare a safe winter harbor for the use of public boats and barges.

As the work of improving the bay, which is most important as an ice harbor, will hereafter be carried on under the appropriation for "improving Quincy Bay," no further appropriation is asked for under this head.

July 1, 1880, amount available		$25,252 72
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$4,375 44	
July 1, 1881, outstanding liabilities	292 58	
		4,668 02
July 1, 1881, amount available		20,584 70

(See Appendix U 13.)

14. *Quincy Bay, Illinois.*—The original project for this work, which included also the construction of 4 dams in the Mississippi River, was presented in 1879, and contemplated the expenditure of $224,000. The work proposed was the dredging of about 700,000 cubic yards of material, some shore protections, &c., in order to afford a large and safe winter harbor capable of accommodating all the vessels that may seek refuge there.

The amount expended to date on this project, under head of "Improving navigation of Mississippi River at Quincy, Ill.," is $24,415.25. Under the present appropriation of March 3, 1881, which is the initial one under the title "Improving Quincy Bay," it is proposed to continue dredging at such various points in the bay as may seem most advantageous. For further dredging, and to build a dredge for use at this point and other localities, an appropriation of $50,000 is asked for by the officer in charge for the fiscal year ending June 30, 1883.

Amount appropriated by act approved March 3, 1881	$10,000 00
July 1, 1881, amount available	10,000 00
Amount (estimated) required for completion of existing project	169,109 87
Amount that can be profitably expended in fiscal year ending June 30, 1883	50,000 00

(See Appendix U 14.)

15. *Mississippi River, at Hannibal, Missouri.*—The original project for this work submitted in January, 1880, contemplated the removal by dredging of large gravel and mud bars in front of Hannibal, and the construction of two spur-dams and one closing-dam on the Illinois side, to confine the channel to the Missouri shore and prevent the bars from reforming. The estimate for performing this work is $60,000, and $24,906.61 have already been expended. During the past year much work was accomplished, which has already been productive of much benefit in opening up several hundred additional feet of wharf and developing a strong current along the Missouri shore. The work consisted of dredging some 54,000 yards of gravel and sand, the construction of a closing-dam from Glasscox Island to the Illinois shore, and the foundation of one of the wing-dams. With the funds available it is

proposed to continue work under the original project, to complete which the sum of $15,000 is asked for for the fiscal year ending June 30, 1883.

July 1, 1880, amount available	$25,000 00	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$45,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		24,906 61
July 1, 1881, amount available		20,093 39
Amount (estimated) required for completion of existing project		15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		15,000 00

(See Appendix U 15.)

16. *Mississippi River, at Louisiana, Missouri.*—The original project contemplates the improvement of the channel of the river in vicinity of Louisiana, so as to afford 6 feet at low-water, by the construction of several dams and shore protections, the estimate for which is $55,000.

Under the initial appropriation of March 3, 1881, of $10,000, work has been commenced on a spur-dam extending from the Illinois shore nearly opposite the steamboat landing, and it is expected that the funds available will be sufficient to complete it for about 1,200 feet of its length.

The officer in charge asks for an appropriation of $45,000 to complete the improvement for the fiscal year ending June 30, 1883.

Amount appropriated by act approved March 3, 1881	$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	48 38
July 1, 1881, amount available	9,951 62
Amount (estimated) required for completion of existing project	45,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	45,000 00

(See Appendix U 16.)

17. *Galena River and Harbor, Illinois.*—The original project for this work, at an estimated cost of $400,000, contemplated extensive dredging in Galena River and Harbor, so as to afford a channel of a minimum depth of 6 feet at low-water from Galena to the mouth of the river. The sum of $49,588 has already been expended in prosecuting this work. During the past year 7,843 cubic yards of material were removed by dredge, making the total quantity to date 225,395 cubic yards. With the funds available dredging will be prosecuted as heretofore. The result thus far is the opening of a channel from 30 to 100 feet wide and from 3½ to 6 feet in depth, at low-water, from the mouth to within about 2,000 feet of Galena, and also extensive improvement in the harbor itself.

It is estimated that $50,000 can be profitably expended during fiscal year ending June 30, 1883.

July 1, 1880, amount available	$15,642 95	
Amount appropriated by act approved March 3, 1881	12,000 00	
		$27,642 95
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		11,230 85
July, 1881, amount available		16,412 10
Amount (estimated) required for completion of existing project		334,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		50,000 00

(See Appendix U 17.)

18. *Cuivre River, Missouri.*—The original project for this work, at an

estimated cost of $30,000, contemplated the improvement of Cuivre River and Cuivre Slough, from its junction with the Mississippi River to Chain of Rocks, about 16½ miles, so as to give at extreme low-water a depth of at least 2 feet. The work consisted of dredging a channel through 7 bars, building a dam across the lower part of Cuivre Slough, and removing snags, wrecks, and impending trees. The sum of $6,627 has already been expended. The work of the past year consisted in dredging a channel 80 feet wide through Shelton Bar, the worst in the river, a channel 60 feet wide through Morrison's Bar, and considerable work at Seed Tick Island. Nearly all of the snags and impending trees have also been removed.

To complete the improvement the sum of $23,000 will be required for the fiscal year ending June 30, 1883.

July 1, 1880, amount available	$2,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$7,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	6,371 46	
July 1, 1881, outstanding liabilities	256 04	
		6,627 50
July 1, 1881, amount available		372 50
Amount (estimated) required for completion of existing project		23,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		23,000 00

(See Appendix U 18.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with the provisions of the river and harbor act of June 14, 1880, Captain Mackenzie was charged with the following surveys:

1. *Mississippi River, at Andalusia, Illinois.* (See appendix U 8.)
2. *Mississippi River, at Louisiana, Missouri.* (See appendix U 16.)

The results of these surveys were submitted to Congress and printed as House Ex. Doc. No. 37, Forty-sixth Congress, third session.

And to comply with provisions of river and harbor act of March 3, 1881, the same officer is charged with *survey for harbor of refuge in Lake Pepin, at Stockholm, Wisconsin, and Lake City, Minnesota.*

The results of this survey will be duly submitted when received.

TEST OF THE ADAMS FLUME.

Preliminary arrangements for making a practical test of the flume invented by Mr. M. J. Adams, for which $20,000 of the appropriation by act of March 3, 1879, for improving Mississippi River from Saint Paul to Des Moines Rapids has been set apart in compliance with the terms of the act, have been in progress during the year under the supervision and direction of the inventor.

The expenditure for these preliminary arrangements to the close of the fiscal year was $5,772, and there remained at that time for completion of the test $14,228.

IMPROVEMENT OF THE DES MOINES RAPIDS OF THE MISSISSIPPI RIVER AND OPERATING THE CANAL.

Officer in charge, Maj. Amos Stickney, Corps of Engineers.

The present project for this improvement was adopted July 19, 1867, the object being to secure a channel over the rapids navigable at all times, with 5 feet depth at extreme low-water stage of the river. This has been essentially secured by the construction of a canal along the west river bank, from the city of Keokuk, Iowa, to the village of Nashville, Iowa, a distance of 7.6 miles, and open cuts through the chains and patches of rock from Nashville to Montrose, Iowa, a distance of about 3.5 miles. The canal is 300 feet wide, with the exception of a little less than 2 miles of its length, which is 250 feet wide. The open cuts when finished are to be 200 feet wide.

The natural channel over the rapids was extremely narrow, crooked, and difficult to navigate even at medium stages of water, and was utterly impassable at extreme low-water for boats of ordinary size; and even lumber rafts were often broken up and a large part of them lost in making the passage. The amount expended to June 30, 1881, is $4,321,485.17 for construction of improvement, and $152,282.83 for operating and maintaining the canal since the opening, August 22, 1877, and has resulted in essentially completing the canal and making a fairly passable channel above the canal. The balance of the amount appropriated up to date, $49,732.08, and the amount asked for, $85,000, are to be applied to the completion of the improvement.

July 1, 1880, amount available	$65,106 50	
Amount appropriated by act approved March 3, 1881	25,000 00	
Amount received by public sales	306 62	
		$90,413 12
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	40,562 62	
July 1, 1881, outstanding liabilities	2,899 14	
		43,461 76
July 1, 1881, amount available		46,951 36
Amount (estimated) required for completion of existing project		85,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		85,000 00

(See Appendix V.)

PRESERVATION OF THE FALLS OF SAINT ANTHONY AND IMPROVEMENT OF THE MISSISSIPPI ABOVE THE FALLS—IMPROVEMENT OF CHIPPEWA AND SAINT CROIX RIVERS, WISCONSIN, AND OF MINNESOTA RIVER AND RED RIVER OF THE NORTH, MINNESOTA AND DAKOTA—RESERVOIRS AT THE SOURCES OF THE MISSISSIPPI—CONSTRUCTION OF DAM AT LAKE WINNIBIGOSHISH.

Officer in charge, Capt. C. J. Allen, Corps of Engineers.

1. *Preservation of Falls of Saint Anthony.*—The work during the fiscal year has consisted in repairs to the apron and the construction of crib and other timber work to protect the ledge on the east side of the apron and the foot of the log sluice from destruction by the action of the floods which are confined to a water-way of discharge of less than 500 feet in width at the apron. The details are stated in Appendix W 1.

The original plan for the preservation of the falls has been carried out; still the work requires protection and constant care.

The sum of $50,000 should be available in order to meet accidents liable to occur.

The amount expended for this improvement to June 30, 1881, is $564,987.84.

Congress, by act of March 3, 1881, appropriated for—

Repairs and contingencies of public works at Saint Anthony's Falls, Minnesota: To meet repairs necessary, present and prospective, fifteen thousand dollars, which shall be available immediately after the passage of this act.

As soon as possible after the funds were made available, steps were taken to commence work of strengthening the toe of the apron; but before it could be commenced the ice moved, and the water attained a stage too high to admit of anything being done before the advent of low-water, when full examinations can be made, plans developed, and the work of strengthening the apron commenced.

July 1, 1880, amount available	$10,444 35	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$25,444 35
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	10,291 33	
July 1, 1881, outstanding liabilities	140 86	
		10,432 19
July 1, 1881, amount available		15,012 16
Amount (estimated) required for completion of existing project		159,726 31
Amount that can be profitably expended in fiscal year ending June 30, 1883.		50,000 00

(See Appendix W 1.)

2. *Mississippi River above the Falls of Saint Anthony, Minnesota.*—The work has principally consisted in the removal of bowlders from the channel, construction of wing-dams and removal of snags and leaning trees between Aitken and Grand Rapids, north of the line of the Northern Pacific Railroad. The stretch of river worked over was about 100 miles, of which 40 miles were quite effectually cleared. Before any work was done navigation by steamer and flat-boats was difficult and precarious on account of the obstructions and rapids. The commerce of this portion of the stream has consisted in carrying supplies to the lumber camps and agencies, and the transportation of lumbermen from Aitken on the line of railroad. Under the head of improvement of the Mississippi River above the Falls of Saint Anthony, two stretches of river have been separately considered; viz, from Minneapolis to Saint Cloud, the cost of improvement of which, by the removal of obstructions and construction of wing-dams, was placed at $144,667.50; and the stretch from Conrad's Shoals (35 miles below Brainerd) to Grand Rapids, the estimated cost of improving which, by the same methods, was placed at $54,127.50.

An appropriation of $20,000 following the adoption of the project for the reach between Minneapolis and Saint Cloud was made by act of August 14, 1876, and expended between that date and 1879, since which time no work has been done. There is, practically, no navigation upon this piece of river. Should Congress, however, order the continuance of this particular work, the sum of $40,000 can be expended during the fiscal year ending June 30, 1883.

With the appropriation of $15,000 for the Mississippi above the falls by act of June 14, 1880, work was commenced between Aitken and Grand Rapids (on the stretch between Conrad's Shoals and Grand Rapids) as noted above. The improvement thus far has been of benefit and has resulted in the building of two new steamers to ply, one between Aitken and Grand Rapids, in addition to the steamer now running, and one to ply between Pokegama Falls and the lumber camps and agencies above.

The act of March 3, 1881, appropriated $10,000 for the river above the falls. With this sum and the balance of funds remaining from previous appropriations it is proposed to continue the work of improvement as begun, and to remove some bowlders from the stream above Grand Rapids, doubling the force employed last season.

The sum of $15,000 can be profitably expended during the fiscal year, ending June 30, 1883, upon the river above Brainerd in removal of obstructions, construction of wing-dams, &c.

There has been expended to June 30, 1881, between Minneapolis and Saint Cloud $45,000; between Conrad's Shoals and Grand Rapids $8,057.96, making a total of $53,057.96.

July 1, 1880, amount available	$16,240 38	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$26,240 38
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	8,233 74	
July 1, 1881, outstanding liabilities	1,064 60	
		9,298 34
July 1, 1881, amount available		16,942 04

Amount (estimated) required for completion of existing project	124,667 50
Amount that can be profitably expended in fiscal year ending June 30, 1883	40,000 00

(See Appendix W 2.)

3. *Construction of Lock and Dam on Mississippi River at Meeker's Island, Minnesota.*—The present project is given in the report of the Chief of Engineers for the fiscal year ending June 30, 1874, and based upon the results of a survey made during that year. The object of the improvement: to connect with the improvement of the Mississippi below Saint Paul so as to secure steamboat navigation up to the Falls of Saint Anthony.

The improvement of the Mississippi River above the Falls of Saint Anthony and from Saint Paul to the Gulf of Mexico has been adopted by Congress, but no appropriations have been made for improving the stream between Saint Paul and the site of the proposed lock and dam at Meeker's Island.

The cost of lock and dam as estimated in the report above referred to is:

Masonry lock, 300 feet long, 80 feet wide, with lift of 17 feet, about	$630,261 46
Timber dam	291,860 00
Total cost of improvement	922,121 46

Congress, by act approved July 23, 1868, made a grant of 200,000 acres of public lands to the State of Minnesota to aid the State in constructing the lock and dam in accordance with plan and estimate previously submitted.

The act of March 3, 1873, appropriated:

> For construction of the lock and dam on the Mississippi River, at Meeker's Island, Minnesota, according to the surveys and plans of the War Department, twenty-five thousand dollars: *Provided*, That all rights and claims in and to the land-grant made to the State of Minnesota for the above work, by act approved July twenty-third, eighteen hundred and sixty-eight, shall be fully relinquished to the United States before any of this appropriation is expended.

No work has as yet been done, the appropriation not being available, as the parties holding the land-grant have not made the required relinquishment.

Until the land-grant above referred to is relinquished to the United States, no appropriation will be asked for this work unless otherwise ordered by Congress.

July 1, 1881, amount available	$25,000 00
Amount (estimated) required for completion of existing project	922,121 46

(See Appendix W 3.)

4. *Chippewa River, Wisconsin.*—The original project for the improve-

ment of this stream from the mouth to Eau-Claire was adopted in 1877, and contemplated the removal of bars and other obstructions to navigation, as well as the revetment of the high sand-banks, known as the Yellow Banks, below Eau-Claire, at a cost of $139,892.50. The first work commenced, in 1877, at the mouth, was the construction of jetties so placed as to narrow the channel to 400 feet in width. The work since that time has consisted in the extension, completion, and repairs to the jetties, and in the construction of dams and jetties for the removal of bars and preservation of channels at Flower-Pot Island, Little Missouri Chûte, and other points above the mouth. The work during the fiscal year past has consisted mostly in repairs to jetties and works at Flower-Pot Bar, the appropriation of June 14, 1880 ($10,000), having become available too late for entering into contract.

The act of March 3, 1881, appropriated $10,000. With this sum and the balance of funds from former appropriations, it is proposed to make the necessary repairs to existing works and to continue the improvement, as begun, up stream from Flower-Pot Island, so far as the funds will admit. Some additional dams will undoubtedly be required between the head of the jetties and the works at Flower-Pot Island, the exact dimensions and location of which can be better ascertained at the close of the present season than now. The additional works apparently most needed at present, and which it is proposed to undertake with the funds at hand, are, at Dark Slough, Five-mile Bluff, Head of Battle Island, and in the vicinity of Plum Island.

The results to date are that where, before any work was done, but 12 inches in depth was the ruling at low-water, there now generally obtains from 3 to 4 feet depth. At the mouth especially the passage of rafts was sometimes impossible and always troublesome before the jetties were commenced. Since their completion detention is unknown at the mouth. The value of this improvement is stated by one of the principal interests in this enormous business in Appendix W 4 of this report. Other points above need, and are receiving, the same improvement as the points named.

Amount expended to date, $31,881.07. Amount that can be profitably expended during fiscal year ending June 30, 1883, is placed at $89,102, viz, $25,000 for channel improvement and $64,102 for the protection of the Yellow Banks.

The necessity of a continuous survey of this stream from Eau-Claire to the mouth has been seriously felt, in order that more accurate estimates of the cost of completing improvement can be made. The cost of such survey is placed at $6,000.

July 1, 1880, amount available	$10,281 91	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$20,281 91
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	3,909 84	
July 1, 1881, outstanding liabilities	253 14	
		4,162 98
July 1, 1881, amount available		16,118 93
Amount (estimated) required for completion of existing project		91,892 50
Amount that can be profitably expended in fiscal year ending June 30, 1883:		
For protecting high sand-banks	$64,100	
For channel improvements	25,000	
		89,100 00

(See Appendix W 4.)

5. *Saint Croix River, Minnesota and Wisconsin.*—The first project for the improvement of this stream was adopted in 1878, based upon a report made in 1874.

The necessity for a full and accurate survey of the stream being apparent, in order that reliable estimates might be arrived at, one was made in 1879, and the estimated cost of improvement placed at $60,250. The improvement contemplates removal of obstructions by dredging bars, removal of snags, leaning trees, bowlders, &c., from the bed of the river, and securing of from 3½ feet to 4 feet depth of water at the low stages by construction of wing-dams and closing of island chutes and secondary channels.

Before any work of improvement was undertaken upon this stream the bed was a mass of snags, old cribs, bowlders, logs, and stumps. The bars also were numerous. By the close of 1880 the worst obstructions had been removed, bends had been revetted where necessary to prevent change in the channel, and several dams constructed.

Above Stillwater, with the exception of two or three crossings, 3 feet of water obtained in the channel at the lowest stage, and the detention at crossings to steamboats, formerly the great hinderance to navigation above Stillwater, is almost unknown. Below Stillwater, in Lake Saint Croix, considerable dredging is required.

Amount expended to June 30, 1881	$26,284 28
Amount expended since adoption, June, 1879, of present project	8,433 60

The act of March 3, 1881, appropriated $8,000 for continuing the improvement. With this sum it is proposed to continue the work above Stillwater, as begun and in progress.

The sum of $30,000 can be profitably expended during the fiscal year ending June 30, 1883, in furthering the work between Taylor's Falls and Prescott and in dredging at Willow River and Catfish Bars.

July 1, 1880, amount available	$10,149 32	
Amount appropriated by act approved March 3, 1881	8,000 00	
		$18,149 32
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	8,057 71	
July 1, 1881, outstanding liabilities	375 89	
		8,433 60
July 1, 1881, amount available		9,715 72
Amount (estimated) required for completion of existing project		42,250 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		30,000 00

(See Appendix W 5.)

6. *Minnesota River, Minnesota.*—No work was done during the fiscal year ending June 30, 1881, for want of funds; some inspections at the mouth, however, were made which have been reported upon.

The project for the improvement of the river from its mouth to South Bend (see page 364, Part I, Annual Report of the Chief of Engineers for 1875) contemplated the construction of five locks and dams and the removal of snags, overhanging trees, and drift-piles, at an estimated cost of $733,868.63

There has been expended to June 30, 1881, the sum of $117,441 in clearing the river of obstructions.

The officer in charge asks for an appropriation of $75,000 for commencement of lock and dam at Little Rapids, but as Congress has not sanctioned the plan of improvement of this river by locks and dams, no appropriation is asked for by this office for next year.

July 1 1880, amount available,		$65 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$6 00	
July 1, 1881, outstanding liabilities	9 00	
		15 00
July 1, 1881, amount available,		50 00
Amount (estimated) required for completion of existing project		733,868 63

(See Appendix W 6.)

7. *Red River of the North, Minnesota and Dakota.*—The work during the past fiscal year has consisted in dredging below Moorhead from the point at which dredging ceased in 1879. About 26 miles were passed over during the year by the dredge, or, since the commencement of work in 1879, 56 miles. In addition, during the fiscal year snags and trees have been removed from the channel. The result of the work to date is, a fair high-water channel from Abercrombie to Fargo, a distance of 76 miles, and a perfected low-water channel, affording 3 feet depth, as the ruling, from Fargo to a point 56 miles below. The shipment of grain by river was, last season, 20 bushels to 1 bushel before any dredging was done.

The present project for the improvement of the river between Breckinridge and the boundary line is based upon the report of the survey of 1877, and is placed at $145,310.18, the cost of lock and dam at Goose Rapids, previously included in the estimate for the general improvement of this river, being excluded.

Amount expended since adoption of present project, $48,700.18, which also represents the amount expended up to June 30, 1881.

The act of March 3, 1881, appropriated the sum of $18,000 for continuing the improvement. With this sum and the balance of funds from former appropriations it is proposed to carry on the work during the coming fiscal year upon the plan already begun; an additional dredging-machine is in process of construction, and two tenders or steam-scows are contemplated in order to carry forward the work more rapidly to the boundary line.

The sum of $25,000 can be profitably expended during the fiscal year ending June 30, 1883, in continuing the dredging between Fargo and the boundary line, and in some work above Moorhead, should such be imperatively needed.

July 1, 1880, amount available	$46,146 42	
Amount appropriated by act approved March 3, 1881	18,000 00	
		$64,146 42
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	9,047 62	
July 1, 1881, outstanding liabilities	798 98	
		9,846 60
July 1, 1881, amount available		54,299 82
Amount (estimated) required for completion of existing project		42,310 18
Amount that can be profitably expended in fiscal year ending June 30, 1883.		25,000 00

(See Appendix W 7.)

8. *Lock and dam at Goose Rapids, on the Red River of the North, Minnesota and Dakota.*—The necessity for a lock and dam at Goose Rapids

has been felt and acknowledged for a number of years. The rapids accumulate, over a stretch of a few miles of river, a fall of 12 to 14 feet, and stand as a dividing wall between the upper and lower halves of this important grain-carrying stream. The Northern Pacific, Saint Paul, Minneapolis and Manitoba, and other railroads constituting the network of the Minnesota and Dakota systems, are more or less intimately connected with the Red River and shipment of wheat from the same.

The various reports upon the Red River of the North since 1874 have contained estimates of the cost of the lock and dam proposed, the estimates varying more or less, according to the particular views held at the time as to size and lift of lock and the variations in prices of materials. The cost at present is estimated at $200,000.

The object of the lock and dam is to overcome, more satisfactorily than by any other means, the current and shoals of the rapids, so as to connect the improvements already made and to be made upon the channels above and below the rapids. Congress has recognized this project by the appropriation of $20,000, by act of March 3, 1881. This appropriation is too small in proportion to the entire cost to warrant its expenditure at the present time, in view of the high price of material and labor in the Northwest. It will be held to add to future appropriation, unless a fall in the price of material should warrant its expenditure.

The sum of $100,000 can be profitably expended during the fiscal year ending June 30, 1883, in carrying on this much-needed improvement.

Amount appropriated by act approved March 3, 1881	$20,000 00
July 1, 1881, amount available	20,000 00
Amount (estimated) required for completion of existing project	180,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	100,000 00

(See Appendix W 8.)

9. *Reservoirs upon the headwaters of the Mississippi River and its tributaries, including experimental dam at Lake Winnibigoshish.*—The report for fiscal year ending June 30, 1880, in noting the appropriation of June 14, 1880—

> For the reservoirs at the headwaters of the Mississippi River, to be used in the construction of a dam at Lake Winnibigoshish, seventy-five thousand dollars: *Provided*, That all injuries occasioned to individuals by overflow of their lands shall be ascertained and determined by agreement or in accordance with the laws of Minnesota, and shall not exceed in the aggregate five thousand dollars—

stated that it was proposed with the funds appropriated to construct a dam of timber and earth so as to raise the lake to a level of about 16 feet above low-water.

Plans were matured during the months of July and August following, but, owing to the opinion rendered by the Attorney-General under date of August 13, 1880, that the above act of Congress did not authorize the Indians of the Leech Lake Agency to dispose of material or the United States to acquire occupancy, no work of construction could be undertaken.

The report of Captain Allen, January 16, 1881, in continuation of former reports, placed the cost of the proposed system of reservoirs (exclusive of cost of damage to land and other property) at $1,809,083.50.

The object of the reservoirs is to collect surplus water, as well as winter and spring precipitation, in sufficient quantity to be released in a systematic and methodical manner to benefit navigation upon the reaches of the several streams below the dams, and ultimately of the main Mississippi, when taken in connection with other works of improvement upon the latter, for a considerable distance below Saint Paul.

Alleviation of effects of floods in localities near the proposed reservoirs is expected to obtain to some extent, but control of extended floods or freshets covering long reaches of river is not anticipated.

In order that benefit to navigation may obtain upon the Mississippi above the mouth of the Saint Croix, the Saint Croix, the Chippewa, and the navigable reaches of the Wisconsin, the system of dams proposed for such should be carried out, and no benefit of any consequence to the Mississippi below Lake Pepin can be predicted unless the entire system is complete.

The plans and estimates presented in the various reports upon surveys and examinations for reservoirs to date have not by any means exhausted the subject. The reservoirs, to be of maximum public benefit, must be operated in the interest of navigation, and not be diverted from that purpose.

The act of March 3, 1881, appropriated $150,000 in addition to the sum appropriated in 1880, the total by the two acts amounting to $225,000, the act of March 3, 1881, reading—

> For reservoirs upon the headwaters of the Mississippi River and its tributaries, one hundred and fifty thousand dollars; and this sum, together with the sum of seventy-five thousand dollars heretofore appropriated for the construction of a dam at Lake Winnibigoshish, shall be expended at such places on said headwaters of the Mississippi River and its tributaries as the Secretary of War shall determine: *And it is provided*, That compensation for any private property taken or appropriated for any of said improvements, and all damages to private property caused by the construction of any of said dams, by flowage or otherwise, shall be ascertained and determined under and in accordance with the laws of the State in which such private property is situated.

With this sum it is proposed to begin the construction of dams at the outlets of Lake Winnibigoshish and Leech Lake, sources of the Mississippi River, as soon as the questions of damages from overflow, occupation, &c., can be settled.

If this work is to continue, the sum of $750,000 can be profitably expended during the fiscal year ending June 30, 1883, provided legal difficulties be removed.

July 1, 1880, amount available	$75,000 00	
Amount appropriated by act approved March 3, 1881	150,000 00	
		$225,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,700 48	
July 1, 1881, outstanding liabilities	414 61	
		2,115 09
July 1, 1881, amount available		222,884 91
Amount (estimated) required for completion of existing project		1,584,083 50
Amount that can be profitably expended in fiscal year ending June 30, 1883.		750,000 00

(See Appendix W 9.)

10. *Surveys for reservoirs at the sources of the Mississippi and its tributaries.*—The officer in charge reports that, in order to meet questions that he thinks will certainly arise, it seems advisable to continue the observations by stationing a gauging party at the outlet of a defined basin at each of the Upper Mississippi, Saint Croix, Chippewa, and Wisconsin River headwaters, and to establish meteorological stations at each, the time to cover not less than a year; observations to be made daily, and, if possible, hourly; also to make borings at all projected dam-sites; to work up past and future records, maps, drawings, estimates, &c. He estimates that for one season's operations, as thus delineated, $49,000 would be required.

July 1, 1880, amount available	$15,000 00	
Amount allotted from act approved March 3, 1881	1,250 00	
		$16,250 00
July 1. 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	11,438 78	
July 1, 1881, outstanding liabilities	457 56	
		11,896 34
July 1, 1881, amount available		4,353 66

(See Appendix W 10.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with the provisions of the river and harbor act of June 14, 1880, Captain Allen was charged with and has completed the following:

1. *Snake River, in Minnesota.* (See Appendix W 11.)
2. *Upper Red River of the North, between Fargo, Dakota, and Breckinridge, Minnesota.* (See Appendix W 12.)
3. *Minnesota River, near the village of Belle Plain, with a view to prevent the breaking away of the banks of the narrow neck of land opposite said village and injury to the navigation of said river in Minnesota.* (See Appendix W 13.)
4. *Mississippi River at Sauk Rapids, near the city of Saint Cloud, Minnesota.* (See Appendix W 14.)

The report upon the last named was printed in Senate Ex. Doc. No. 51, Forty-sixth Congress, third session, and the reports upon the others in House Ex. Doc. No. 22, Forty-sixth Congress, third session.

5. * * * *Completion of the survey of the reservoir system on the headwaters of the Mississippi River, including Rock River, in Wisconsin and Illinois.*

The reports upon these surveys were printed in Senate Ex. Doc. No. 48, Forty-sixth Congress, third session. (See also Appendix W 10.)

The results of the examination of the sources of the Rock River were reported upon separately, in order to meet a pressing demand; this report also appears in House Ex. Doc. No. 22, Forty-sixth Congress, third session.

And to comply with provisions of the river and harbor act of March 3, 1881, Captain Allen has been charged with the following, the results of which will be duly submitted when received:

1. *Beaver Bay, Minnesota, to ascertain the cost and practicability of making it a harbor of refuge.*
2. *Grand Portage Bay and Wans-wau-goising Bay, Minnesota, to determine which, if either, should be made a harbor of refuge.*
3. *The headwaters of the Cannon River, in Minnesota, with a view that the same may be added to the reservoir system of the Upper Mississippi.*

IMPROVEMENT OF TENNESSEE AND CUMBERLAND RIVERS, AND OF RIVERS IN EASTERN TENNESSEE AND GEORGIA.

Officer in charge, Maj. W. R. King, Corps of Engineers, having under his immediate orders Capt. L. Cooper Overman, Corps of Engineers, and until April 12, 1881, Lieut. W. L. Marshall, Corps of Engineers.

1. *Tennessee River.—a. Above Chattanooga.*—The necessity for the improvement of this river was recognized as early as 1830, when an examination was made, and subsequently some work was done in the way of channel excavation, building wing-dams, &c., both by State and national authority.

When this river, from Chattanooga to Knoxville, a distance of 189 miles, was examined in 1872, it was found that, although navigable at high-water, it was obstructed at some twenty-nine points by rock reefs, gravel bars, shoals, &c., and the present project, adopted at that time, was for the removal of these obstructions, so as to secure a navigable channel at least 3 feet deep at low-water. Twenty-one of them had been so far removed at the end of the fiscal year that they are either no obstructions or comparatively slight ones. Most of the work done heretofore has been confined to improvements below Loudon, but during the past year the improvement of the troublesome obstructions at *Chota* and *Coulter's Shoals* have been completed and work at *Little River Shoals* begun, all between Loudon and Knoxville, while some work has been done in rebuilding and strengthening a dam at *Half Moon Island*, below Kingston.

In order to fully utilize the work already done, the other troublesome shoals between Knoxville and Loudon should be removed and some of the shoals already partially completed below Loudon should be finished.

To this end the balance of the present appropriation, and that herein estimated for ($16,500), and even a larger sum, can be profitably expended, the nature of the work being, as heretofore, permanent, if thoroughly completed as that now being done. Amount expended to June 30, 1881, is $202,772.90.

b. Below Chattanooga.—This part of the river has also been navigated for more than half a century, from Chattanooga to the Ohio River, a distance of 443 miles, with the exception of the great obstruction at Muscle Shoals, which forms a barrier to all navigation excepting a very dangerous passage down stream.

The principal improvement required on this part of the river consists in the building of a canal with locks and dams around the Muscle Shoals, and the present project, which was adopted in 1872 and modified in 1877, consists in building such a canal, and the improvement of all other obstructions between Chattanooga and Paducah by channel excavation, wing-dams, &c.

The work has made good progress throughout the year, and on the first of July last was in the following condition:

On the Elk River Shoals Division, the heavy channel excavation required near the upper end of these shoals was two-thirds completed, and three-eighths of the stone retaining-dams. The channel will be open by the middle of September. Quarrying and cutting stone for the two locks was well under way, and one of the lock-pits was two-thirds excavated. About 17½ acres of land required for the short canal had been bought and cleared of heavy timber.

Blue Water and Shoal Creek Divisions (Muscle Shoals Canal).—*Five* of the nine locks required have been built, and are ready for the gates. The masonry of the other four is so far advanced that it can easily be finished in one year of continuous work. The Shoal Creek aqueduct piers, and those of the Blue Water dam and bridge, were well advanced at the close of the fiscal year and expected to be finished during the summer. The canal trunk was about as reported last year, but little work having been done on it during the fiscal year, but it is more than three-fourths done, and can be finished in one year, work on it now making rapid progress.

Little Muscle Shoals Division.—A channel 2,300 feet long and 110 feet wide, through the upper reefs of this obstruction, was completed, and the seven wing and retaining dams were so far completed that the channel is now navigable over the entire shoals.

During the past winter and spring a steamboat drawing three feet of water has been employed in towing barges over this shoal from below Florence up to the lower end of the canal. But little further work will therefore be required on this division for the present.

At *Colbert Shoals*, *Duck River Shoals*, and other points below Florence, no work has been done, but there has been procured from the pilots navigating that part of the river a list of all the troublesome obstructions on that part of the river, and it is proposed to start a snag-boat at once with the necessary outfit of drills and dynamite for blasting bowlders, to go over the whole lower river, if possible, during the present low-water season.

It is also very desirable that during the next season attention may be given to certain low-water obstructions in the river between Decatur and Chattanooga, so that they may be out of the way when the Muscle Shoals Canal is opened.

For the purposes just specified, and for continuing the operations at Muscle Shoals as indicated, the balance of the present appropriation and that herein asked for ($700,000) will be necessary.

Attention is invited to the report of the engineer in charge of the work, giving the circumstances of a robbery committed on the line of the canal in March last, by which the sum of $5,240 in government funds was taken from the messenger carrying the same to the engineer camps for the payment of employés.

Amount expended to June 30, 1881, is $1,823,650.61.

Above Chattanooga.

July 1, 1881, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	7,000 00	
		$17,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	9,495 46	
July 1, 1881, outstanding liabilities	1,777 44	
		11,272 90
July 1, 1881, amount available		5,727 10
Amount (estimated) required for completion of existing project		16,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		16,500 00

Below Chattanooga.

July 1, 1880, amount available	$311,048 24	
Amount appropriated by act approved March 3, 1881	250,000 00	
		$561,048 24
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	258,173 85	
July 1, 1881, outstanding liabilities	31,025 00	
		289,198 85
July 1, 1881, amount available		271,849 39
Amount (estimated) required for completion of existing project		2,037,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		700,000 00

(See Appendix X 1.)

2. *Cumberland River.*—As early as 1830 the legislature of Tennessee appropriated money for the improvement of the Cumberland River, and the State of Kentucky took similar action at an early day. Although but little was done, some of the work is still in existence.

a. Below Nashville (a distance of 192 miles).—The present project for improving this section of the river is to secure an increased depth of channel at low-water by excavating a channel through rock, gravel, &c., and by narrowing the water-way at shoal places.

Work has been done during the year at Palmyra Island, Upper and Middle Gatlin, Race Track, and Little River Shoals, at which points the improvements are reported from five-eighths to nine-tenths completed. The balance of the funds available, and those herein estimated for, will be needed for completing these improvements and others not yet undertaken of a similar nature.

Amount expended to June 30, 1881, $206,383.

July 1, 1880, amount available	$23,961 11	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$38,961 11
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	24,455 24	
July 1, 1881, outstanding liabilities	888 87	
		25,344 11
July 1, 1881, amount available		13,617 00
Amount (estimated) required for completion of existing project		28,821 00
Amount that can be profitably expended in fiscal year ending June, 30, 1883.		28,800 00

b. Above Nashville.—Nashville to Kentucky line (229 miles).—The obstructions receiving attention are Cub Creek, Hollyman's Island and Sand Shoals, and Bartlett's Bar, at which points the improvements are reported from seven-eighths to nine-tenths completed. In addition to this, the channel at various other points was improved by the removal of snags, bowlders, and overhanging trees.

The project for the improvement contemplates the formation of a navigable channel through the various obstructions so as to give increased depth for navigation at and above a 2-foot stage of water. At lower stages locks and dams would be required to secure navigation for boats of any serviceable capacity.

The balance of funds on hand, and those herein estimated for, will be needed to complete the work at the points mentioned and to extend it to other similar obstructions on this section.

Amount expended to June 30, 1881, $63,805.83.

July 1, 1880, amount available	$18,673 92	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$33,673 92
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	13,661 58	
July 1, 1881, outstanding liabilities	818 17	
		14,479 75
July 1, 1881, amount available		19,194 17
Amount (estimated) required for completion of existing project		39,155 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		39,700 00

c. Kentucky line to Smith's Shoals (129 miles).—In this section there were thirty-two obstructions needing more or less improvement, and the project contemplates forming a channel through them so that steamboats can navigate this part of the river when the water is above a 3-foot stage.

Work was done at Harmon's Creek, Wolf Creek, and Wild Goose Shoals, and a snag-boat was employed at various other points on the section.

The funds on hand and those herein estimated for will be needed for continuing operations on the worst of these obstructions, the work to be done consisting, as on the section just mentioned, in rock and gravel excavation, building stone dams to contract the water-way, &c.

Amount expended to June 30, 1881, $30,370.43.

July 1, 1880, amount available	$14,228 99	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$29,228 99
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	9,968 16	
July 1, 1881, outstanding liabilities	631 26	
		10,599 42
July 1, 1881, amount available		18,629 57
Amount (estimated) required for completion of existing project		42,609 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		43,000 00

d. Smith's Shoals (8 miles long).—This obstruction consists of four very shallow and rapid shoals, which at low-water are almost dry, but at high-water become a torrent, and the project for improvement contemplates such deepening and smoothing of the rocky bed of the river as will enable coal-boats to descend at 4 and 5 foot stages of the river.

A change has been made during the last year in the channel on the lower part of Long Shoals (the most serious of these obstructions), and the result has proved highly satisfactory as far as experience has extended. The channel has been shifted to the north side of the river, and the dams and rock excavation have been so far completed as to justify the expectation that they will need no further appropriation at present.

A survey has been ordered for the purpose of ascertaining the practicability and cost of improving these shoals by locks and dams, and when this is reported on, and the boatmen have had an opportunity of thoroughly testing the work already done, there will be an opportunity for Congress to decide whether to undertake the more radical system of improvement.

Amount expended to June 30, 1881, $92,929.06.

July 1, 1880, amount available	$20,315 65	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$30,315 65
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	20,823 22	
July 1, 1881, outstanding liabilities	2,421 49	
		23,244 71
July 1, 1881, amount available		7,070 94

e. Above the mouth of Jellico (110 miles).—An appropriation of $10,000 was made for this part of the Cumberland at the last session of Congress, but no work has been done up to the end of the fiscal year. Arrangements are now making (August 15), however, to transfer the organized force from Smith's Shoals to that work as soon as they complete the former work.

The present project is to improve the channel from Cumberland Ford to the mouth of Jellico Creek by removing bowlders, snags, &c., and, if found practicable and the owners consent, to modify the numerous mill dams that bar all safe navigation. Should these dams be removed or properly modified, safe rafting may probably be carried on for at least three months in the year. The engineer officer in charge will make an investigation regarding the mill-dams.

No expenditures have yet been made. The appropriation of $15,000 asked for is to be applied to continuing the work as indicated by the project.

Amount appropriated by act approved March 3, 1881	$10.000 00
July 1, 1881, amount available	10,000 00
Amount (estimated) required for completion of existing project	45,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	15,000 00

(See appendix X 2.)

3. *Hiwassee River, Tennessee.*—This is a tributary of the Tennessee River. Some work was done upon this stream, between forty and fifty years ago, by the State of Tennessee, though with little permanent benefit to navigation. The obstructions are rock reefs, bowlders, gravel bars, &c. The present project is to reduce the reefs and bars, remove the loose rock, snags, &c., from the channel, and to build wing-dams, thus forming a channel at least 2 feet deep and 40 feet wide between Savannah Ford and the mouth of the river, a distance of about 33 miles. The amount expended to June 30, 1881, is $25,741.74, which has resulted in obtaining a permanently useful channel for steamboats as high as Charleston, except during extreme low-water, and above Charleston the improvement has given a good channel to many grain-laden boats which have recently made the passage.

The appropriation of $2,500 asked for is to be applied to completing the improvement above Charleston as originally projected.

July 1, 1880, amount available	$3,000 00	
Amount appropriated by act approved March 3, 1881	1,500 00	
		$4,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outsanding liabilities July 1, 1880	2,405 48	
July 1, 1881, outstanding liabilities	336 26	
		2,741 74
July 1, 1881, amount available		1,758 26
Amount (estimated) required for completion of existing project		2,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		2,500 00

(See Appendix X 3.)

4. *French Broad River, Tennessee.*—The French Broad River joins the Holston River near Knoxville, after a course of about 121 miles in Tennessee.

Some attempts were made by the State, about forty years ago, to improve this stream, but without any permanent advantage to navigation. Most of the wing-dams built by the State have been ruined by fish-traps, &c.

The obstructions are principally rock reefs, bowlders, gravel bars, snags, &c., in the channel. The present project is to reduce the reefs and bars, remove the loose rocks, snags, &c., and cut down the overhanging trees, repairing, where practicable, the old dams, and building new wing-dams to contract the water-way so as to secure 2½ feet of water as high as Leadvale. Above that point, a slackwater navigation is the only feasible one. The amount expended to June 30, 1881, is $4,660.12, and has secured the improvement of seven principal obstructions. The work at Fain's Island has permitted the passage of grain-laden boats; a passage which would not otherwise have been attempted on that stage of water.

The appropriation of $15,000 asked for is to be applied to continuing the improvement as stated.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	3,500 00	
		$13,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	3,820 12	
July 1, 1881, outstanding liabilities	840 00	
		4,660 12
July 1, 1881, amount available		8,839 88
Amount (estimated) required for completion of existing project		136,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		15,000 00

(See Appendix X 4.)

5. *Clinch River, Tennessee.*—The Clinch River enteres the Tennessee River at Kingston, after a course of about 230 miles in Tennessee. Efforts were made by the State as early as 1830, and since, to improve this stream, without any marked success, though several of the old wing-dams then built are standing.

The channel was obstructed by large bowlders, gravel shoals, rock ledges extending across the water-way above low-water, mill-dams, fish-traps, and leaning trees. The present project is to remove the most dangerous obstructions down to extreme low-water, and to build wing-dams where necessary to secure increased depth of water.

It is proposed to obtain at ordinary low-water 2 feet from Kingston to Clinton, and about 1½ feet from Clinton to Hayne's.

During the year ten principal obstructions have been improved and the channel permanently made useful. The amount expended to June 30, 1881, was $3,753. The appropriation of $10,000 asked for is to be applied in continuing this improvement both above and below Hayne's.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$13,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	3,404 39	
July 1 1881, outstanding liabilities	348 61	
		3,753 00
July 1, 1881, amount available		9,247 00
Amount (estimated) required for completion of existing project		13,400 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		10,000 00

(See Appendix X 5.)

6. *Duck River, Tennessee.*—The Duck River enters the Tennessee about 14 miles above Johnsonville.

The natural channel is obstructed by short gravel bars and ridges, snags, logs, and overhanging trees.

The present project consists in removing these obstructions and building wing-dams, so as to secure from 2½ feet to 3½ feet of water during the boating season of from four to six months.

The amount expended to June 30, 1881, is $2,799.18 and has resulted in improving the channel between Five Island Shoals and Wilke's Shoals, a distance of 10 miles. The work was making good progress at the end of the fiscal year. The appropriation of $10,000 asked for is to be applied to clearing and narrowing the channel between Centreville and the mouth of the river.

July 1, 1880, amount available	$7,000 00	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,598 03	
July 1, 1881, outstanding liabilities	201 15	
		2,799 18
July 1, 1881, amount available		7,200 82
Amount (estimated) required for completion of existing project		25,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		10,000 00

(See Appendix X 6.)

7. *Obey's River, Tennessee.*—This river enters the Cumberland River at Celina, Tenn., about 3 miles south of the Kentucky State line.

The channel is obstructed by gravel bars, loose rock, reefs, snags, overhanging trees, &c.

The present project is to take out these obstructions and to build riprap dams to help navigation at high-water during four or five months in the year for boats drawing less than 3 feet of water.

The amount expended to June 30, 1881, is $3,124.78, which has secured a partial clearing of the channel from Barnes's Landing, head of navigation, to its mouth. Good progress was making at the close of the year. The appropriation of $5,400 asked for is to be applied to continuing the improvement, as indicated in the project.

The engineer officer in charge suggests the correction of the spelling in the name of this stream. It evidently should be *Obey's*, not *Obed's*, and the Senate passed an amendment making the correction, but it was not changed in the bill as passed.

July 1, 1880, amount available	$4,000 00	
Amount appropriated by act approved March 3, 1881	2,500 00	
		$6,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,280 05	
July 1, 1881, outstanding liabilities	1,844 73	
		3,124 78
July 1, 1881, amount available		3,375 22
Amount (estimated) required for completion of existing project		5,369 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		5,400 00

(See Appendix X 7.)

8. *Caney Fork River, Tennessee.*—This river enters the Cumberland River near Carthage, Tenn.

The natural channel is much obstructed by gravel shoals, rock ledges, snags, and overhanging trees. The State of Tennessee, forty or fifty years ago, did some work upon this stream without securing permanent advantages to navigation.

The present project provides for removing these obstructions and building wing-dams to assist navigation at moderately high-water for boats drawing less than 3 feet of water, the season of navigation being usually from February to June. The amount expended to June 30, 1881, is $4,867.75. The boating interests appear satisfied with what improvement has been attained; but sufficient work has not yet been done to justify a definite statement of results. Good progress was making at the close of the year.

The appropriation of $12,000 asked for is to be applied in continuing the improvement as indicated by the project.

July 1, 1880, amount available	$6,000 00	
Amount appropriated by act approved March 3, 1881	4,000 00	
		$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	3,867 51	
July 1, 1881, outstanding liabilities	1,000 24	
		4,867 75
July 1, 1881, amount available		5,132 25
Amount (estimated) required for completion of existing project		20,228 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		12,000 00

(See Appendix X 8.)

9. *Coosa River, Georgia and Alabama.*—The Coosa River is the main tributary of the Alabama River and is formed by the confluence of the Oostenaula and Etowah.

The State of Alabama, in 1823, passed an act to improve its navigation. The obstructions between Rome and Greensport are gravel bars, rock reefs, bowlders, &c., the gravel bars being most troublesome to improve, as they form again at intervals.

Below Greensport.—Rocky ledges cross the river causing it to spread and giving it a fall of 24 feet in 5 miles. The present project, above Greensport, is to remove the obstructions and to excavate a channel at least 3 feet deep at extreme low-water, by blasting the rock in bed and building wing-dams to cause the current to scour out the softer materials.

Below Greensport the plan is to construct a canal around Whistenant's Shoals and Ten Islands Shoals, consisting of three locks and dams, using the Wood's Island chute as the canal trunk, the canal thus formed being nearly 2 miles long, from 100 to 250 feet wide, with from 5 to 10 feet depth of water.

The amount expended to June 30, 1881, is $206,098.41, and has resulted in the removal, wholly or in part, of the worst obstructions above Greensport, and securing a fair navigable channel throughout the year, between Rome and Greensport. At the Ten Islands Shoals Canal lock No. 1 is finished, ready for the gates, and its longitudinal dam is nearly built; the pit of lock No. 2 is excavated and nine-tenths of its stone quarried and cut; the quarrying and cutting of the stone for lock No. 3 is well under way.

The appropriation of $175,000 asked for, is to be applied to continuing the work upon the Ten Islands Shoals Canal, and such work as may be found necessary above Greensport. It is expected that the completion of this work and the building of a dam at Broken Arrow Shoals, and certain minor improvements at shoals between the canal and that point, will extend navigation down to the upper edge of the coal fields of Saint Clair County.

July 1, 1880, amount available	$97,850 10	
Amount appropriated by act approved March 3, 1881	60,000 00	
		$157,850 10
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	72,092 81	
July 1, 1881, outstanding liabilities	6,855 70	
		78,948 51
July 1, 1881, amount available		78,901 59
Amount (estimated) required for completion of existing project		267,347 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		175,000 00

(See Appendix X 9.)

10. *Oostenaula and Coosawattee Rivers, Georgia.*—These streams are in Northwestern Georgia. The State of Georgia, about fifty years ago, appropriated moneys to improve their navigation, having in view water communication between the Tennessee and the Coosa rivers.

The obstructions are snags, bowlders, gravel bars, &c. The present project is to remove these obstructions, to build wing-dams, and to excavate the rock bed so as to secure 3 feet depth of water on the Oostenaula and 2 feet on the Coosawattee during nine months of the year. The amount expended to June 30, 1881, is $24,120.49 and has secured a good channel in the Coosawattee, amply sufficient for all its commerce, and a much improved channel in the Oostenaula, securing 20 inches depth at low-water on Gideon's Shoals and Clark's Shoals.

The appropriation of $3,200 asked for is to be applied in continuing the channel improvement of the Oostenaula as originally projected.

July 1, 1880, amount available	$2,777 28	
Amount appropriated by act approved March 3, 1881	1.000 00	
		$3,777 28
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,794 52	
July 1, 1881, outstanding liabilities	103 25	
		2,897 77
July 1, 1881, amount available		879 51
Amount (estimated) required for completion of existing project		3,208 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		3,200 00

(See Appendix X 10.)

11. *Etowah River, Georgia.*—This river is tributary to the Coosa. In the last 63 miles of its course, it has a fall of nearly 3.7 feet per mile, and not sufficient water for navigation without locks and dams. It is also obstructed by fish traps, mill-dams, &c. An appropriation of $10,000 was made by act of 1876, and the stream was resurveyed in 1879, and a project and estimates submitted for its improvement by locks and dams, to give a navigable channel 4 feet deep, from Rome, Ga., to mouth of Little River.

No work has been done, excepting that relating to the necessary survey of 1879. The amount expended to June 30, 1881, is $1,237.80. No appropriation is asked for, but the engineer officer in charge recommends that Congress authorize that the balance unexpended ($8,762.20) be applied to the improvement of the Coosa River, near Rome, Ga., where the Etowah merges into the Coosa.

July 1, 1880, amount available	$8,762 20
July 1, 1881, amount available	8,762 20

(See Appendix X 11.)

12. *Ocmulgee River, Georgia.*—This river is in Central Georgia, and joining with the Oconee forms the Altamaha.

The obstructions are snags, sunken rafts, sand and gravel bars, and occasional rock reefs. The natural channel is winding and shifting, and the caving in of the banks adds to the number of obstructions continually. The present project is to remove these obstructions and straighten the channel at certain points. The amount expended to June 30, 1881, is $43,442.11, and has resulted in securing a tolerably clear and useful channel, having about 3½ feet of water, between Hawkinsville and the mouth of the river. Work at Hubbard's Shoals and Winslow Point was in active progress at the close of the year. Although much of the work done is of a permanent nature, it is probable that a small force will be required from time to time to remove obstructions that develop in future.

The appropriation of $7,300 asked for is the balance of the original estimate of cost, and is to be applied in continuing work as projected, having in special view the improvements at Hubbard's Shoals and Winslow Point.

July 1, 1880, amount available	$7,583 86	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$12,583 86
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	6,416 75	
July 1, 1881, outstanding liabilities	609 22	
		7,025 97
July 1, 1881, amount available		5,557 89
Amount (estimated) required for completion of existing project		7,240 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		7,300 00

(See Appendix X 12.)

13. *Oconee River, Georgia.*—The Oconee and Ocmulgee from the Altamaha River.

The natural channel is obstructed by snags, sand bars formed by sunken logs, a few reefs, &c.

The State of Georgia appropriated, fifty or sixty years ago, for improving the navigation of this river, but without any known permanent advantages. The present project is to clear the channel and reduce the rock reefs at Carr's Shoals, so as to furnish an outlet for the commerce of Dublin and its vicinity. A snag-boat will be necessary for use a part of each year to remove the accumulated logs, drift, &c. The amount expended to June 30, 1881, is $12,648.22, which has secured an improved channel and an increased depth of about 18 inches above Dublin. The appropriation of $10,000 asked for is to be applied to clearing the channel and the removal of rock reefs, especially at Carr's Shoals, above Dublin, and extending the improvement below Dublin to the mouth of the river as originally projected.

July 1, 1880, amount available	$1,879 19	
Amount appropriated by act approved March 3, 1881	2,500 00	
		$4,379 19
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,502 41	
July 1, 1881, outstanding liabilities	25 00	
		1,527 41
July 1, 1881, amount available		2,851 78
Amount (estimated) required for completion of existing project		34,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		10,000 00

(See Appendix X 13.)

14. *Red River, Tennessee.*—This stream is the largest tributary to the Cumberland below Nashville, and enters that river at Clarksville, and is navigable for about four months in the year for vessels drawing 15 inches of water. The channel is greatly obstructed by snags, loose rock, overhanging trees, and gravel shoals. The project adopted is to remove these obstructions between Port Royal and the mouth of the river.

No work has yet been done upon this stream, but a working party will be sent there during the present low-water season. The work can be made permanently useful with a small annual outlay for removing the snags and logs that gather yearly.

The first appropriation was made by act of 1881. There have been no expenditures. The total estimated cost of the improvement can be profitably expended at once.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount available	5,000 00
Amount (estimated) required for completion of existing project	5,103 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	5,100 00

(See Appendix X 14.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with provisions of the river and harbor act of June 14, 1880, Major King was charged with and completed the following, the results of which were transmitted to Congress:

1. *Clinch River, in the counties of Hancock, Hawkins, and Claiborne, Tennessee, and Scott and Russell counties, Virginia.* (See Appendix X 5.)

2. *Holston River, in the counties of Sullivan, Hawkins, Grainger, and Hamblen, Tennessee, and Washington and Scott counties, Virginia.* (See Appendix X 15.)

The above are printed in House Ex. Doc. No. 77, Forty-sixth Congress, third session.

3. *Powell River, in the counties of Hancock and Claiborne, Tennessee, and Lee County, Virginia.* Printed in Senate Ex. Doc. No. 52, Forty-sixth Congress, third session. (See also Appendix X 16.)

4. *The headwaters of the Savannah River in connection with the headwaters of the Hiwassee and Tennessee rivers, to ascertain if the waters of the Hiwassee and Tennessee can be united with the waters of the Savannah River by means of a canal.* (See Appendix X 17.)

5. *Red River from Port Royal, Montgomery, County, Tennessee to its mouth.* (See Appendix X 18.)

The above numbers, 4 and 5, are printed in House Ex. Doc. No. 57, Forty-sixth Congress, third session.

6. *South Fork of Cumberland River, Kentucky.*—Printed in House Ex. Doc. No. 91, Forty-sixth Congress, third session. (See also Appendix X 19.)

And to comply with the provisions of the river and harbor act of March 3, 1881, he is charged with and is now engaged upon the following, the results of which will be duly submitted when received:

1. *Bear Creek, running from Northeast Mississippi into the Tennessee River.*

2. *Little Tennessee River from its mouth on the Holston, or Big Tennessee River, to the mouth of Tellico River.*

3. *Cumberland River, at Smith's Shoals, in the State of Kentucky, to ascertain the practicability and the cost of a canal, with locks and dams, from the head to the foot of said shoals.*

IMPROVEMENT OF THE NAVIGATION AT THE FALLS OF THE OHIO—OPERATING AND MAINTAINING THE LOUISVILLE AND PORTLAND CANAL.

Officer in charge, Maj. G. Weitzel, Corps of Engineers.

1. *Improvement of the Falls of the Ohio River.*—Previous to February 26, 1872, when the improvement first became of any practical benefit to commerce, the natural channel-way at this point was by means of the three chutes over the falls. The main chute (Indiana chute) was navigable for descending boats from three to five months, and for ascending boats about one or one and one-half months in the year.

A canal built by private parties around the falls on the Kentucky side, called the Louisville and Portland Canal, permitted the passage of vessels not exceeding 185 feet in length and 50 feet in breadth, and was, therefore, only available for the smaller class of vessels which were then navigating the rivers of the Mississippi basin.

The project for this improvement was adopted in 1868, and its object was to deepen, widen, and enlarge the Louisville and Portland Canal, to complete the new locks and branch leading to them (which work had been begun in 1860 by the Louisville and Portland Canal Company, and stopped for want of funds in 1866). Since then the project has been extended by the action of Congress, so as to include the improvement of the Indiana chute.

The amount expended to June 30, 1880, is $1,448,838.50.

On this date and ever since February 26, 1872, this improvement has permitted the passage of boats not exceeding 335 feet in length and 80 feet in width.

During the year ending June 30, 1881, $2,600.97 has been expended. The only advantages that have resulted from this have been to bring the work nearer to the point of its final completion.

If the stage of the river permits, the whole amount allotted by the acts of June 14, 1880, and March 3, 1881 ($60,000), can be profitably expended during the year ending June 30, 1882, in improving the Indiana chute, and the advantages of this improvement will consist in improving the natural main navigable channel over the falls, and thus relieve the artificial channel, or Louisville and Portland Canal, in periods when commerce is crowded at this point.

The estimated amount required for the entire and permanent completion of the Indiana chute is $70,000.

During last year 4,196 vessels, with a registered undertonnage of 1,124,838 tons, passed by this point by the canal; and 1,723, with a tonnage of 517,361 tons, passed by the natural channel. Total number of vessels, 5,919. Total registered undertonnage, 1,642,199 tons. In addition to a very large amount of general merchandise, these vessels carried the following amount of the three chief staples: 29,086,100 bushels of coal, 73,400 barrels of salt, and 53,660 tons of iron-ore.

July 1, 1880, amount available	$24,361 70	
Amount appropriated by act approved March 3, 1881	50,000 00	
		$74,361 70
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,600 97
July 1, 1881, amount available		71,760 73
Amount (estimated) required for completion of existing project		70,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		70,000 00

(See Appendix Y 1.)

2. *Operating and maintaining the Louisville and Portland Canal.*—The government assumed charge of this canal on June 11, 1874. During the past year it has been open two hundred and eighty days, and closed forty-one days by high-water, twenty-five by ice, and nineteen for repairs; 4,196 boats, with a registered undertonnage of 1,124,838 tons, passed through the canal.

The available balance on hand July 1, 1881, was $7,615.18.

The act of March 3, 1881, provides that thereafter the Secretary of War is authorized to draw his requisition on the Secretary of the Treasury, from time to time, for the purpose of operating and keeping this canal in repair.

(See Appendix Y 2.)

IMPROVEMENT OF OHIO AND MONONGAHELA RIVERS AND OF ALLEGHENY RIVER, PENNSYLVANIA—CONSTRUCTION OF HARBOR OF REFUGE NEAR CINCINNATI, AND OF ICE HARBOR AT MOUTH OF MUSKINGUM RIVER, OHIO.

Officer in charge, Maj. William E. Merrill, Corps of Engineers, having under his immediate orders Lieut. F. A. Mahan, Corps of Engineers, until May 19, 1881, when the latter officer was temporarily relieved, on account of sickness, by Lieut. William M. Black, Corps of Engineers.

1. *Ohio River—Davis Island.*—Both walls of the lock at Davis Island have been completed to the coping; the stone floor of the Chanoine dam at head of the lock has also been completed. The lock-chamber has been excavated to grade, and about three-fourths of the guiding-crib at the head of the lock has been built; 2,282 cubic yards of cut stone, 2,226 cubic yards of rubble, and 3,248 cubic yards of concrete masonry have been laid during the year, and 11,881 cubic yards of earth excavation has been made in the chamber of the lock. Considerable progress has also been made in the construction of the wickets, &c., for the navigable pass.

Portland Bar.—The substructure of this dike has been built to a length of 446 feet, and the superstructure has been finished for a length of 360 feet.

Grand Chain.—The dike at the head of the Grand Chain has been extended to a length of 1,200 feet, and the superstructure is finished for a length of 1,075 feet. Total proposed length, 3,000 feet. The substructure of the dike at foot of the chain has been built to a length of 1,600 feet, and the dike has been finished for a length of 1,330 feet. Total proposed length, 3,000 feet.

Dredging.—The dredges Ohio and Oswego have been employed in excavating for the improvement of navigation at Brush Creek Island, at New Richmond, Ohio, at Cincinnati, Ohio, at Three-Mile Creek, at Callom's Ripple, at Riverside, Ohio, and at Warsaw Bar. A total of 62,740 cubic yards of gravel and 7,955 cubic yards of loose-rock excavation was made during the year, at an average cost of 22.8 cents per cubic yard. Fifty-eight snags and one wreck were also removed by the dredges.

Snagging.—The snag-boat E. A. Woodruff began work on July 14, and closed for the season on December 16; 1,025 snags were removed during the season, and thirty-seven wrecks were also either wholly or partly removed.

Removal of rocks.—The reef known as the "Upper Center Rock" was removed from the channel at the Little Chain, as well as the outlying rocks of a group at the lower end of the chain. About 150 cubic yards were also removed from the reef known as the "Grenadier Rocks," near the head of the Grand Chain.

The officer in charge presents the following estimate for the ensuing year:

Davis Island Dam	$200,000 00
Snagging	25,000 00
Dredging	16,500 00
New hull for dredge Oswego	24,000 00
Removing rocks	5,000 00
Dams and dikes	572,500 00
Engineering and contingencies	25,000 00
	868,000 00

July 1, 1880, amount available	$350,980 74	
Amount appropriated by act approved March 3, 1881	350,000 00	
		$700,980 74
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	231,087 07	
July 1, 1881, outstanding liabilities	23,545 31	
		254,632 38
July 1, 1881, amount available		*446,348 36
Amount that can be profitably expended in fiscal year ending June 30, 1883.		868,000 00

(See Appendix Z 1.)

2. *Monongahela River, West Virginia and Pennsylvania.*—No work of construction has been done during the fiscal year.

Under the appropriations of June 14, 1880, and March 3, 1881, the title to land required for lock and dam No. 8, at Dunkard Creek, has been acquired by the United States; and a contract has been awarded for furnishing the stone needed for the lock and for the abutment of the dam.

The officer in charge recommends an appropriation of $69,000 to complete the lock at Dunkard Creek, and to pay the running expenses of lock No. 9.

July 1, 1880, amount available	$25,000 00	
Amount appropriated by act approved March 3, 1881	25,000 00	
		$50,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		4,430 81
July 1, 1881, amount available		45,569 19
Amount (estimated) required for completion of existing project		139,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		69,000 00

(See Appendix Z 2.)

3. *Allegheny River, Pennsylvania.*—The dam at Six-Mile Island, which was seriously damaged by ice during the winter of 1879–'80, has been put in complete repair. This dam turns the water at the 4-foot stage, and is believed to be a permanent improvement.

The riprap dam at Nicholson Rapids was also considerably injured during the winter, and it was deemed advisable to replace it by a crib dam ballasted with stone. This new dam is built on the upper edge of the old riprap dam, and is a thoroughly substantial work.

The navigation of the Allegheny, especially in the upper portion of the river, is much obstructed by rocks, and a crane-boat together with four independent auxiliary parties was employed in their removal. The result of this work was the removal of 3,960 large rocks, a great proportion of which were first broken up by blasting, besides some 850 cubic yards of bowlders from the shoal places; 15 snags were also removed by these parties. A small sum was also expended in dredging at the mouth of the river, but without marked result.

The officer in charge recommends an additional appropriation of $50,000 for the general improvement of the river.

July 1, 1880, amount available	$20,001 36	
Amount appropriated by act approved March 3, 1881	25,000 00	
		$45,001 36

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* This includes the amount transferred to the improvement of Indiana Chute.

July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$19,852 11
July 1, 1881, amount available	25,149 25
Amount that can be profitably expended in fiscal year ending June 30, 1883.	50,000 00

(See Appendix Z 3.)

4. *Harbor of Refuge near Cincinnati, Ohio.*—The dike on the Ohio side at Four-Mile Bar has been completed with a total length of 2,135 feet. The Kentucky dike has been built to a length of 1,950 feet, the height of the walls varying from two courses to the full height. The timber work is finished for a length of 728 feet.

The officer in charge recommends the construction of a third dike to complete this improvement, at an estimated cost of $33,000.

July 1, 1880, amount available		$21,303 43
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$16,490 43	
July 1, 1881, outstanding liabilities	4,813 00	
		21,303 43
Amount (estimated) required for completion of existing project		33,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		33,000 00

(See Appendix Z 4.)

5. *Ice harbor at mouth of Muskingum River, Ohio.*—Work was begun on July 29, 1880, and was continued until stopped by cold weather on November 24. It was resumed on May 4, 1881, and continued to the end of the fiscal year.

A coffer-dam has been constructed above the State dam across the Muskingum at Marietta of sufficient capacity to inclose the upper half of the new lock which is to be built in the pool, and 7,500 cubic yards of excavation has been made within this coffer.

In addition to the above, some 2,200 cubic yards of excavation has been made to open a new mill-race outside of the coffer-dam.

Fifteen hundred and thirty-nine cubic yards of dimension stone and 2,152 cubic yards of rubble-stone have been delivered for the lock, under contract with Thomas P. Townsend, dated February 16, 1880. Considerable progress has been made in cutting this stone ready for laying, and some 600 cubic yards of stone has been broken for the foundations of the lock.

A large and valuable plant has been collected, and, with a favorable season, it is expected that a good showing will be made by the close of the working season.

The officer in charge submits the following estimate for the ensuing year:

Original estimated cost of lock	$216,400 00
Amount already appropriated	110,000 00
Required to complete lock	106,400 00

July 1, 1880, amount available	$74,771 97	
Amount appropriated by act approved March 3, 1881	30,000 00	
		104,771 97
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	47,953 40	
July 1, 1881, outstanding liabilities	8,067 53	
		56,020 93
July 1, 1881, amount available		48,751 04
Amount (estimated) required for completion of existing project		106,400 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		106,400 00

(See Appendix Z 5.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with provisions of the river and harbor act of June 14, 1880, Major Merrill was charged with and has completed the following, the results of which were transmitted to Congress:

1. *Ice harbor, Bellaire, Belmont County, Ohio.* (See Appendix Z 6.)
2. *The Ohio River at the head of Hurricane Island and Elizabethtown, Illinois.* (See Appendix Z 1.)
3. *For the construction of two ice-breakers in the Ohio River, near the West Virginia shore, and below the railroad bridge crossing said river at Parkersburg.* (See Appendix Z 7.)
4. *Ice harbor at Point Pleasant, West Virginia.* (See Appendix Z 8.)

The above were printed in House Ex. Doc. No. 49, Forty-Sixth Congress, third session.

5. *Youghiogheny River, to begin at its mouth at McKeesport, Allegheny County, and end at Connellsville, Fayette County, Pennsylvania.* Printed in House Ex. Doc. No. 20, Forty-sixth Congress, third session. (See also Appendix Z 9.)
6. *Red Bank Creek, Pennsylvania, from its mouth on the Allegheny River to Brookville.* Printed in House Ex. Doc. No. 86, Forty-sixth Congress, third session. (See also Appendix Z 10.)

And to comply with provisions of the river and harbor act of March 3, 1881, he is charged with and is now engaged upon the following, the results of which will be duly submitted when received:

1. *Survey of the Clarion River from its mouth to Ridgeway, Pennsylvania*

IMPROVEMENT OF KENTUCKY RIVER AND OF TRADEWATER RIVER, KENTUCKY; OF BIG SANDY RIVER KENTUCKY AND WEST VIRGINIA; AND OF GUYANDOTTE AND LITTLE KANAWHA RIVERS, WEST VIRGINIA.

Officer in charge, Maj. James W. Cuyler, Corps of Engineers.

1. *Kentucky River, Kentucky.*—The present project is that of restoring the old State slackwater works, in the lower 100 miles of the river, and the progressive building of new works to extend slackwater 158 miles further up, to the Three Forks.

The first work undertaken was that of the restoration of the old works, which has been conducted in the face of considerable difficulties. This restoration is now so far advanced that it is calculated to complete it, so far as to reopen slack-water navigation through the four lower works (a length of 82 miles), by December 10, 1881.

The navigation afforded will be a 6-foot one, with locks of 160 feet available boat capacity, having lifts averaging 14 feet. The dams will be of timber crib-work, filled in with riprap stone, backed with gravel, of an average length of 450 feet, and height (from foundation in lower pool) of 22 feet. These dams will be "step-dams," and in plan straight dams, at right angles (nearly) to the locks. They will be built upon the foundations of the old dams, the clear breaches in these being closed with new work, founded upon the bed of the river, and securely tied into the old foundations.

As explained in the last annual report, work was not begun upon this improvement until May, 1880, under the first appropriation for it of March 3, 1879.

It is proposed to apply the appropriation of March 3, 1881, to rebuilding dam No. 5 and abutment, and renovating its lock, to rebuilding dam

No. 4, and to acquiring land, and preparing for building the new lock No. 6.

July 1, 1880, amount available	$198,170 91	
Amount appropriated by act approved March 3, 1881	125,000 00	
		$323,170 91
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	170,195 39	
July 1, 1881, outstanding liabilities	14,162 26	
		184,357 65
July 1, 1881, amount available		138,813 26
Amount (estimated) required for completion of existing project		749,402 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		228,000 00

(See Appendix A A 1.)

2. *Big Sandy River, West Virginia and Kentucky.*—The present project, so far as improving the natural channels, was adopted in 1878, and for slackwater navigation, in 1880; the object of the first plan being to improve the raft and push-boat navigation in low stages, and of the second to afford a permanent 5-foot navigation. The natural channels are narrow, obstructed, and with as little as 3 inches of water in them, at low stages, over shoals and ripples.

The plan of open river improvement adopted in 1878 had at the end of the fiscal year placed the main river, from Louisa to the mouth—26 miles—in good navigable condition, with 18 inches of water at extreme low stages, in the channel and chutes, and in the upper river, both the Louisa and Tug Forks in about the same condition, the latter to Piketon, 87 miles above Louisa, and the former to a point 81 miles above Louisa.

The appropriation of $65,000 asked for is for carrying to completion the lock and dam, near Louisa, $60,000, and for continuing and maintaining the open river improvement, $5,000.

July 1, 1880, amount available	$54,948 15	
Amount appropriated by act approved March 3, 1881	50,000 00	
		$104,948 15
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	8,471 49	
July 1, 1881, outstanding liabilities	938 06	
		9,409 55
July 1, 1881, amount available		95,538 60
Amount (estimated) required for completion of existing project		65,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		65,000 00

(See Appendix A A 2.)

3. *Guyandotte River, West Virginia.*—The present plan of improvement for this river was adopted in 1878, and operations have been carried on, mainly, in accordance with it. This plan comprised an improvement of the whole river for raft navigation up to Logan Court-House, 81½ miles. Last season the plan was enlarged, to extend the same improvement continuously above Logan, as far up as it was expedient to go, this upper section being closed to navigation except at the flood stages of the river. The amount expended to June 30, 1881, is $4,415.09, which has perceptibly made the navigation easier.

The appropriation of $2,000 asked for fiscal year 1882–'83 is to extend up stream the present improvement, maintaining at same time the whole line now improved in its present condition for navigation.

July 1, 1880, amount available	$2,308 78	
Amount appropriated by act approved March 3, 1881	3,500 00	
		$5,808 78
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		1,723 87
July 1, 1881, amount available		4,084 91
Amount that can be profitably expended in fiscal year ending June 30, 1883.		2,000, 00

(See Appendix A A 3.)

4. *Little Kanawha River, West Virginia.*—The present project adopted in 1880 proposes extending slackwater navigation up the river some 12 miles above the slackwater navigation of the Navigation Company.

The additional lock and dam provided for by river and harbor act of June 14, 1880, have been located, and it is proposed with the funds now on hand from the appropriations of June 14, 1880, and March 3, 1881, $53,000, to begin constructing these works, the lock being taken up first, and bring them well to completion, for which the funds asked for fiscal year 1882–'83 are estimated by the officer in charge as sufficient.

July 1, 1880, amount available	$14,757 00	
Amount appropriated by act approved March 3, 1881	40,000 00	
		$54,757 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,820 88	
July 1, 1881, outstanding liabilities	200 00	
		2,020 88
July 1, 1881, amount available		52,736 12
Amount (estimated) required for completion of existing project		31,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		31,000 00

(See Appendix A A 4.)

5. *Improvement of Tradewater River, Kentucky.*—An appropriation of $3,000 was made by the river and harbor act of March 3, 1881, for the improvement of the open navigation of this river. This sum will be applied during this season, so soon as the stage of water admits, to blasting out a channel 70 feet wide through the rock bar above the mouth, to insure egress into the Ohio, and removing the worst natural obstructions to general navigation as far up as the funds appropriated will go. To continue the work on the plan as adopted, in order to fully utilize what work will be done the present season, will require, approximately, $7,000, which amount is asked for fiscal year 1882–'83, to be applied to extending up river and enlarging improvement to be effected this working season.

Amount appropriated by act approved March 3, 1881	$3,000 00
July 1, 1881, amount available	3,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	7,000 00

(See Appendix A A 5.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with provisions of the river and harbor act of June 14, 1880, Major Cuyler was charged with the following, the results of which were transmitted to Congress and printed in House Ex. Doc. No. 60, Forty-sixth Congress, third session:

1. *Tradewater River, Kentucky.* (See Appendix A A 5.)

And to comply with provisions of the river and harbor act of March 3, 1881, he is charged with the following, the results of which will be duly submitted when received:

1. *Licking River, from its mouth to Falmouth, in Kentucky.*

IMPROVEMENT OF WABASH RIVER, INDIANA AND ILLINOIS, AND OF WHITE RIVER, INDIANA.

Officer in charge, Maj. Jared A. Smith, Corps of Engineers.

1. *Wabash River, Indiana and Illinois.*—The improvements upon this river have made navigable, at all stages of water, a considerable portion of the river where for years before no navigation had been practicable, save at very high stages. The channel had been obstructed by reefs, snags, and bars, and it was narrow, crooked, and uncertain.

The principal improvements have been Coffee Island Chute; bank protection and wing-dam near Grayville, Ill.; dam in New Harmony Cut-off; dam across Turkey Island Chute; wing-dam and shore protection at New Harmony; removal of reef at Warwick's Ripple; channel through reef and construction of dike at Grand Chain; wing-dam at Winkler's Bar; dam across Little Chain Cut-off; removal of snags.

Numerous other small improvements have been made.

During the last fiscal year the larger portion of the reef in the channel at Warwick's Ripple has been removed; 830 linear feet of dike has been built on the east side of chute at Grand Chain, and a part of the reef in the head of the chute has been removed.

At *Winkler's Bar* a wing-dam has been extended 750 feet.

At *McIntyre's Bar* the shore has been protected from cutting by a work 550 feet long.

At *New Harmony* a shore protection has been constructed 714 feet long, with a wing-dam 64 feet in length.

Repairs have been made to the dam in New Harmony Cut-off, and further arrangements have been made for stopping the drift.

The snag-boat has removed 202 snags and 103 overhanging trees, besides towing barges with materials for other works of improvement.

The survey of the river has been completed to the head of Grand Chain, and a special survey has been made at Coffee Island.

The object of the improvements has been to secure a good channel of not less than 3½ feet of water at all stages.

This result is now fairly accomplished over the portion of the river from Grand Chain to a point 10 miles above Grayville, Ill. Other portions have been considerably improved.

The river has recently come into extensive use in transporting the products of adjacent counties, thus benefiting and developing the resources of its valley.

The amount expended to June 30, 1881, is $327,155.04. This includes snag-boat, barges, machinery, and a large amount of plant, which is on hand for future use.

An appropriation of $75,000 is asked for the next fiscal year, to be applied to removing snags, improving channel at Coffee Island Chute, completing improvements at Grand Chain and Little Chain, and removing bars below Little Chain by means of wing-dams, and other similar work.

In addition to the above a separate estimate is submitted by the officer in charge, amounting to $130,000, for commencing a lock and dam at Grand Rapids, of which $65,000 could be profitably expended in the first year of the work.

Wabash River above Vincennes.—The act of March 3, 1881, provided that $25,000 should be expended in improving the river above Vincennes.

As no surveys or improvements of this part of the river have been made, the only work which could be commenced at once was the removal of snags. Further work will await the result of surveys and examinations which will be made this season.

The improvements will consist in confining the channel by shore protections and wing-dams. Although these cannot now be definitely indicated, there is no doubt that a further appropriation of $50,000 could be profitably spent in improving these points. The amount thus far expended is $2,967.32.

July 1, 1880, amount available	$25,003 81	
Amount appropriated by act approved March 3, 1881	50,000 00	
		$75,003 81
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	26,096 40	
July 1, 1881, outstanding liabilities	5,737 30	
		31,833 70
July 1, 1881, amount available		43,170 11
Amount that can be profitably expended in fiscal year ending June 30, 1883.		125,000 00

(See Appendix B B 1.)

2. *White River, Indiana.*—The original project for improving this river to near Portersville on the East Fork, and the falls on the West Fork, contemplated making a channel of not less than 2 feet at the lowest stages of water.

With the class of boats used on this river such a channel will accommodate a large traffic.

The amount expended to June 30, 1881, is $32,911.89. This includes the purchase and outfit of a snag-boat and other plans for use in future work.

During the last year 218 snags were removed, and 228 overhanging trees were cut away.

Two-new barges have been built and one of them has been fitted with an engine and other machinery for a pile-driver.

A party has commenced the improvement at Kelly's Ripple.

The work of constructing wing-dams is also fairly commenced. A survey of the river has been completed from its mouth to Hazleton, a distance of 18 miles.

The work thus far done has considerably improved the navigation between Hazleton and Petersburg, though the increase in depth of channel cannot be definitely stated.

The amount of $50,000 can be profitably expended on this improvement during the next fiscal year.

July 1, 1880, amount available	$24,162 65	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$44,162 65
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	12,068 54	
July 1, 1881, outstanding liabilities	2,674 23	
		14,742 77
July 1, 1881, amount available		29,419 88
Amount (estimated) required for completion of existing project		85,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		50,000 00

(See Appendix B B 2.)

BRIDGING THE NAVIGABLE WATERS OF THE UNITED STATES.

1. *Bridge across the Arkansas River at Little Rock.*—A Board of officers of the Corps of Engineers was convened in May, 1873, to examine and

report whether a bridge that was being constructed at the time over the Arkansas River at Little Rock by the Cairo and Fulton Railroad Company would seriously obstruct or impair the navigation of the river.

In the report submitted the Board felt it necessary, as this was the first bridge erected over the Arkansas River, to discuss the conditions which, in their opinion, should govern the construction of bridges over that stream.

An occasion having lately arisen to refer to this report, it was found that its publication in the annual report of this office of 1873 had been overlooked at the time. It is now inserted in the appendix of this report for future reference.

(See Appendix C C 1.)

2. *Bridge across the Mississippi River at Sabula, Iowa.*—This bridge was authorized by section 7 of "An act to authorize the construction of a bridge across the Mississippi River at or near the town of Clinton in the State of Iowa, and other bridges across the said river, and to establish them as post-roads," approved April 1, 1872, and is to be built by the Chicago, Milwaukee and Saint Paul Railway Company, the successors of the Sabula, Ackley and Dakota Railroad Company.

The location and plan of the bridge after due examination by this office was, upon its recommendation, approved by the Secretary of War July 17, 1880.

(See Appendix C C 2.)

LAKE HARBORS AND RIVERS.

IMPROVEMENT OF HARBOR AT DULUTH, MINNESOTA, AND OF THE ENTRANCE TO SUPERIOR BAY, LAKE SUPERIOR — IMPROVEMENT OF THE HARBOR AT GRAND MARAIS, MINNESOTA.

Officer in charge, Capt. C. J. Allen, Corps of Engineers.

1. *Harbor at Duluth, Minnesota.*—Before the work of dredging commenced in this harbor, the entrance through the canal was precarious, and the anchorage ground within the bay limited, inadequate, and insecure. By 1878 the dredged area had much increased, but scarcely keeping pace with the demands of commerce. In 1880 the wants of navigation required not only the usual enlargement of the harbor area, but the dredging of a convenient channel leading from the Northern Pacific Railroad docks, past the blast furnaces on Rice's Point, down to the intersection with the channel of the Saint Louis River, and considerable work was done on that line to the great benefit of navigation. By the close of the season of 1880, vessels drawing 16 feet of water could enter the canal and navigate the harbor in the vicinity of the docks and the channel to the Blast Furnaces with safety. The harbor is now pronounced, by competent authority, the best for entrance of any on the chain of lakes.

The amount expended to June 30, 1881, is $288,313.51, of which $51,069.09 has been expended for construction, maintenance, and repairs of piers bordering the canal, and $128,237.18 for dredging.

The work done during the fiscal year past has consisted in dredging and repairs to, and renewal of some portions of, the piers.

The present project, as to dredging, is based upon the report and estimates of a Board of Engineers convened in January last, by order of the Secretary of War, at the request of the Chamber of Commerce of Duluth

(See Appendix D D 3), and contemplates the maintenance of the dredged areas and enlargement of the harbor by dredging:

1. On a line from Rice's to Minnesota Point.

2. On a line from the Blast Furnace docks to intersect with the channel of the Saint Louis River.

3. On a line parallel to Minnesota Point; and 4, along the west side of Rice's point in Saint Louis Bay.

The total cost being placed at $187,988.36.

The maintenance of the piers bordering the canal is of the utmost importance to this harbor.

The officer in charge recommends a reserve fund of $10,000 to $15,000 for their repair, and with which to meet effects of the severe northeast storms.

It is thought that $25,000 in addition to what is now on hand will suffice to maintain the piers in repair for some years to come.

The act of March 3, 1881, appropriated $40,000; with this sum it is proposed to continue the dredging, mainly on the line past the Blast Furnaces.

The sum of $100,000 can be profitably expended during the fiscal year ending June 30, 1883, as follows:

For dredging (of which about $25,000 for dredging along the west side of Rice's Point towards or up to the north shore of Saint Louis River)	$90,000 00
Repairs to piers	10,000 00

The title to a strip of land on each side of the canal from the bay to the lake, and the title to Minnesota Point from the dike to the northern terminus of the land owned by the United States for light-house purposes, should be obtained; or at least such control over it as will prevent the destruction of the timber and vegetation upon it, the retention of which is necessary to the preservation of the Point.

Attention is earnestly urged to this matter by the officer in charge.

July 1, 1880, amount available	$31,239 71	
Amount appropriated by act approved March 3, 1881	40,000 00	
		$71,239 71
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	28,179 81	
July 1, 1881, outstanding liabilities	5,324 21	
		33,504 02
July 1, 1881, amount available		37,735 69
Amount (estimated) required for the completion of existing project		172,988 36
Amount that can be profitably expended in fiscal year ending June 30, 1883:		
For dredging	90,000 00	
For repairs of piers	10,000 00	
		100,000 00

(See Appendixes DD 1 and DD 3.)

2. *Dredging Superior Bay, Wisconsin.*—The principal work for the improvement of this harbor was done prior to 1875, and consisted in the construction of the piers bordering the entry connecting the deep-water of the bay with deep-water of the lake, and dredging between the piers and in the bay up to the Quebec Wharf, so as to afford a depth of 14 feet of water.

The trade of Superior City declined until 1880; consequently the channels fell somewhat into disuse, and no dredging having been done since 1874, some shoals were developed between the piers and in the Quebec Channel, reducing the ruling depth to 11 feet.

Work since 1875 has mainly consisted in repairs to piers, and the preservation of Minnesota Point, upon the preservation of which the Bay of Superior as a harbor and anchorage ground depends.

The Board of Engineers convened in January, 1881, to consider the necessity of further improvement of the Bay of Superior, recommended enlargement of the harbor area and channel facilities by—

1. Deepening the channel in the Entry between the piers;
2. Dredging channel from the Entry past the mouth of Nemadji River, around and parallel to the shore of Superior Bay, to Quebec Wharf;
3. Thence from Quebec Wharf along the west side of the bay to an intersection with the channel of the Saint Louis River opposite Connor's Point; and
4. Up the Nemadji River for about one-half a mile;

the whole at a cost of $287,080.

The preservation of the piers by means of such repairs as may be needed from time to time is placed at $25,000, making the total cost of present project $312,080.

The amount expended prior to the adoption of present project, which also represents the total amount expended to June 30, 1881, is $335,513.26, of which about $310,885.10 has been expended in construction and maintenance of piers and beach protection, and $24,628.16 for dredging.

There is now on hand, to meet repairs for the coming fiscal year, $7,870.54.

The work for the past fiscal year consisted in repairs to and preservation of piers and beach.

The necessity of some steps being taken by Congress to preserve Minnesota Point against erosion is referred to in the report upon the harbor of Duluth for this fiscal year.

Both harbors are interested vitally in the preservation of the Point.

With the appropriation of March 3, 1881, it is proposed to dredge in the bay of Superior between the piers at the entry, along a line leading from the entry into and up the Nemadji River, and in the Quebec Wharf Channel and vicinity.

The sum of $85,000 can be profitably expended during the fiscal year ending June 30, 1883, in dredging and preservation of piers and beach.

July 1, 1880, amount available	$9,473 33	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$19,473 33
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,533 55	
July 1, 1881, outstanding liabilities	69 24	
		1,602 79
July 1, 1881, amount available		17,870 54
Amount (estimated) required for completion of existing project		302,080 00
Amount that can be profitably expended in fiscal year ending June 30, 1883:		
For dredging	75,000 00	
For piers and beach protection	10,000 00	
		85,000 00

(See Appendixes DD 2 and DD 3.)

3. *Harbor at Grand Marais, Minnesota.*—The work during the past fiscal year consisted in dredging. The largest vessels can now enter the harbor.

The original project, adopted in 1879, and based upon the survey of 1874, contemplated dredging within the area bounded by Mayhew's Point and the inner shore line to sufficient extent to afford anchorage ground, with 16 feet of water for vessels seeking refuge in the harbor during storms, and the construction of a breakwater jutting out from

Mayhew's Point to narrow the entrance and afford additional shelter and anchorage.

Estimated cost of original project	$139,669 40
Amount expended to June 30, 1881	14,677 41

With the appropriation of March 3, 1881, and the small balance from former appropriations, it is proposed to commence the construction of the breakwater and carry it on as far as the funds will admit, leaving the completion of the breakwater and necessary dredging to be accomplished under future appropriations.

The sum of $40,000 can be profitably expended during the fiscal year ending June 30, 1883, for continuing the construction of the breakwater and for dredging. The officer in charge believes that this sum will meet the wants of the harbor for some years to come.

July 1, 1880, amount available	$12,422 87	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$32,422 87
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	6,995 54	
July 1, 1881, outstanding liabilities	104 74	
		7,100 28
July 1, 1881, amount available		25,322 59
Amount (estimated) required for completion of existing project		99,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883, in continuing breakwater and dredging		40,000 00

(See. Appendix DD 4.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with provisions of the river and harbor act of March 3, 1881, Captain Allen has been charged with, and is now engaged upon, the following, the results of which will be duly submitted when received:

1. *Beaver Bay, Minnesota, to ascertain the cost and practicability of making it a harbor of refuge.*

2, *Grand Portage Bay and Waus-wau-goising Bay, Minnesota, to determine which, if either, should be made a harbor of refuge.*

HARBORS ON LAKE SUPERIOR (EAST OF SUPERIOR CITY), ON GREEN BAY, AND ON THE WESTERN SHORE OF LAKE MICHIGAN, NORTH OF MILWAUKEE, WISCONSIN.

Officer in charge, Maj. Henry M. Robert, Corps of Engineers.

1. *Ontonagon Harbor, Michigan.*—The present project for the improvement of this harbor was adopted in 1867, with the object of affording a channel of entrance to the mouth of Ontonagon River, of navigable width, and not less than 12 feet deep. The natural channel was variable in position, with not more than 7 feet water at the shoalest point.

The amount expended to June 30, 1880, is $195,922.27, and resulted in securing a channel 125 feet wide, carrying temporarily not less than 11 feet depth of water, with about 750 linear feet of pile pier, and 2,690 linear feet of crib pier.

During the fiscal year ending June 30, 1881, $19,942.77 were expended in adding eight cribs to the piers, partial superstructure over four cribs, and full superstructure over three cribs, and in removing 10,546½ cubic yards of sand from the bar, and the remains of old cribs which obstructed the channel.

During the fiscal year 1881–'82 nine cribs will be built and placed in extension of the piers, and partial superstructure will be built over five cribs.

The appropriation of $60,000 asked for during the fiscal year ending June 30, 1883, will be applied to further pier extension.

The officer in charge recommends that no funds be again appropriated specifically for dredging, as such work is of but temporary benefit, the bar reforming after every freshet. Rapid extension of the piers to deep water can alone be relied on to secure the channel.

July 1, 1880, amount available	$21,677 73	
Miscellaneous receipts	20 00	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$41,697 73
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		19,942 77
July 1, 1881, amount available		21,754 96
Amount (estimated) required for completion of existing project		126,170 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		60,000 00

(See Appendix E E 1.)

2. *Eagle Harbor, Michigan.*—The improvement of this harbor was completed in 1879, as far as the present demands of commerce require. The project contemplated a further expenditure of $176,362, but no appropriation is asked. The work is in good condition, and the funds on hand are ample for its maintenance for some time. During the past fiscal year a small quantity of stone filling was put into the guiding cribs. There has been expended on this work to June 30, 1880, the sum of $93,000, and $132.47 during the fiscal year 1880–'81. The channel secured by the improvement is 130 feet wide and 14 feet deep, and was excavated across a rocky reef which obstructed the entrance to the harbor.

July 1, 1880, amount available	$4,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	132 47
July 1, 1881, amount available	3,867 53

(See Appendix E E 2.)

3. *Marquette Harbor, Michigan.*—The present project for the improvement of this harbor was adopted in 1866, modified in 1875, and was carried out at a cost of $293,674.71, including repairs to date, or about $91,500 less than the original estimate. The object of the improvement, consisting of a breakwater 2,010 feet long, was to afford a harbor of refuge to the commerce of Lake Superior and protection to vessels lying at dock.

The breakwater is exposed to violent storms and needs considerable repairs. During the past year 22,592 feet, board measure, of plank was relaid, having been broken up by the direct impact of the falling water during a severe gale. The repairs which are most urgently needed will be made this season as far as the available funds will permit, but at least $16,000 should be appropriated at an early date, in order to put this work into good order. Since 1875 only $6,500 has been appropriated for this work. The breakwater should be extended eventually 400 feet further, at a cost, as estimated, of $68,000, which is the modification of the project alluded to above.

July 1, 1880, amount available	$5,006 36
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	451 07
July 1, 1881, amount available	4,555 29
Amount (estimated) required for completion of existing project	68 000 00
Amount that can be profitably expended for repairs in fiscal year ending June 30, 1833	18,000 00

(See Appendix E E 3.)

4. *Harbor of refuge at Grand Marais, Michigan.*—There has been appropriated for this work the sum of $30,000, of which $1,910.06 has been expendedto June 30, 1881, on a survey, and borings over the site of the proposed improvement. It is proposed to hold the available funds until further appropriations accumulate sufficiently to allow of an economical commencement of work. The plans have been referred to a Board of Engineers, whose report will be found in Appendix E E 4.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$30,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		1,910 06
July 1, 1881, amount available		28,089 94
Amount that can be profitably expended in fiscal year ending June 30, 1883.		70,000 00

(See Appendix E E 4.)

5. *Manistique Harbor, Michigan.*—By the acts of 1880 and 1881 the sum of $6,000 was appropriated for the improvement of this harbor, the object of which is to dredge a channel 150 feet wide, with a depth of about 12 feet, between piers built by a local lumbering company. During the fiscal year ending June 30, 1881, 11,780 cubic yards were removed.

No further operations are contemplated after the available funds are exhausted.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	1,000 00	
		$6,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,316 32	
July 1, 1881 outstanding liabilities	176 70	
		2,493 02
July 1, 1881, amount available		3,506 98

(See Appendix E E 5.)

6. *Menomonee Harbor, Michigan and Wisconsin.*—The project for the improvement of this harbor was adopted in 1871, and modified in 1874, with the object of affording a channel of navigable width and of not less that 14 feet depth. The natural channel was narrow, with not more than 4 feet water at the shoalest point. The amount expended to June 30, 1880, is $153,000, and has resulted in securing a channel 200 feet wide with a depth of not less than 10 feet. During the fiscal year ending June 30, 1881, $9,779.23 were expended in adding four cribs to the south pier, and building superstructure over six cribs in the north pier, and dredging 2,500 cubic yards from the channel. Six cribs and partial superstructure over four cribs will be added during the present season. The appropriation asked for during the fiscal year 1882-'83, of $37,000, is the full amount remaining unappropriated of the estimate, and is proposed to be applied to pier extension and the necessary dredging.

A recent survey of the lake bed in the vicinity of the pier heads shows that the bar to the south of the entrance is being greatly augmented by the dumping of material dredged from the river by the mill owners, a practice which has been in operation for years and still continues. The officer in charge reports that these parties, who should be the most deeply interested in the preservation of the harbor, manifest the greatest apathy in regard to stopping the practice, and that there seems to be no local authority to control this destructive habit, as Menomonee, Mich., and Menekaunee, Wis., on opposite sides of the river, exist under simple township organizations. He recommends that the expenditure of future appropriations be made contingent on the establishment of local authority for the control of the harbor.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	12,000 00	
		$22,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		9,779 23
July 1, 1881, amount available		12,220 77
Amount (estimated) required for completion of existing project		37,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		37,000 00

(See Appendix E E 6.)

7. *Oconto Harbor, Wisconsin.*—The act of March 3, 1881, appropriated $10,000 for the improvement of this harbor, after an examination of the work being done by the citizens, and a report from Maj. D. C. Houston, Corps of Engineers, that an appropriation of $5,000 or $10,000 would be of great assistance. The officer in charge reports that the citizens' plan is extremely defective, and is based on erroneous estimates of the cost of making an improvement which would be of any commercial value. As the probable cost for the cheapest possible work would be about $125,000 for an 8-foot channel, or $382,000 for a permanent 12-foot channel, and as the citizens' estimate, upon which the appropriation was based, was, for a 10-foot channel only, $27,475.20, it was deemed best, with the approval of the Secretary of War, to direct that the subject be again presented to Congress, and that the appropriation of March 3, 1881, be not expended until further legislative action is had thereon.

The officer in charge recommended that, if Congress should decide to proceed with the work, a sufficient sum, about $50,000, be appropriated to permit of an economical commencement of operations.

Amount appropriated by act approved March 3, 1881	$10,000 00
July 1, 1881, amount available	10,000 00
Amount (estimated) required for completion of existing project	115,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	50,000 00

(See Appendix E E 7.)

8. *Green Bay Harbor, Wisconsin.*—The project for this harbor improvement was adopted in 1866, and modified in 1872, its object being to secure a channel 200 feet wide and not less than 14 feet deep at the shoalest part, with a length of about 2 miles, extending from the mouth of Fox River to deep water in Green Bay, and including a revetted cut through Grassy Island. An additional modification has recently been made, due to a lowering of the plane of reference 1 foot, the former datum plane being found not to represent mean low-water of the lake. The natural channel was circuitous and narrow, with not more than 6 feet water at the shoalest point.

The expenditures to June 30, 1880, were $235,548.52, and resulted in obtaining a channel over 2 miles in length and 200 feet in width, with a least depth of 13 feet for half its width, and of 10 feet for the other half width. During the fiscal year ending June 30, 1881, $6,150.49 was expended in removing irregularities in the channel; 26,345$\frac{4}{10}$ cubic yards were removed. During the present season further dredging will be done, and the same work is contemplated with the appropriation asked for 1882–'83.

July 1, 1880, amount available	$6,001 48	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$11,001 48
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		6,150 49
July 1, 1881, amount available		4,850 99
Amount (estimated) required for completion of existing project		67,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		27,000 00

(See Appendix E E 8.)

9. *Harbor of Refuge at entrance to Sturgeon Bay Canal, Wisconsin*.—The project for the improvement of this harbor was adopted in 1873, and modified in 1879, and again in 1880; the object being to protect the lake entrance of the canal, and to afford an outer basin of navigable width, and of at least 13 feet depth. The modifications of the original project consisted of 1,392 linear feet of sheathing for the pile piers, 330 linear feet of guide piling, and over 300 linear feet of crib pier at the entrance; but they will not add to the estimated cost of the work as a whole. The amount expended to June 30, 1880, was $84,484.51, resulting in 794 linear feet of pile pier and 400 linear feet of crib pier, on each side, the latter being as yet unfinished. During the fiscal year ending June 30, 1881, six cribs were built and sunk on the outer detached extension, three on each pier; 1,238 linear feet of sheathing was built on pile piers, 8,164 cubic yards of dredging was done in the channel, and superstructure commenced over the crib-pier work. A survey was made of the harbor, and its vicinity. The expenditures during the fiscal year 1880–'81 aggregated $34,868.32, including $2,000 outstanding liabilities on July 1, 1881. The harbor is now well protected, and has a channel of from 50 to 60 feet in width and 13 feet least depth from the entrance to the mouth of the canal.

During the present season the detached extension will be completed, and superstructure will be well advanced over the piers, leaving about $5,000 worth of work remaining to complete the piers, and the dredging of 180,000 cubic yards of material to complete the project. The appropriation asked for, if granted, will be applied to this work during the fiscal year ending June 30, 1883.

July 1, 1880, amount available	$35,515 49	
Miscellaneous receipts	84 00	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$45,599 49
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	32,868 32	
July 1, 1881, outstanding liabilities	2,000 00	
		34,868 32
July 1, 1881, amount available		10,731 17
Amount (estimated) required for completion of existing project		50,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		50,000 00

(See Appendix E E 9.)

10. *Ahnepee Harbor, Wisconsin*.—The present project was adopted in 1875, and modified in 1880 by the addition of sand-tight sheathing to the pile pier; the object being to afford a limited inner harbor, and an

entrance channel of not less than 12 feet in depth. The natural channel was narrow, with a least depth of 1 foot. The amount expended to June 30, 1880, including expenditures prior to the adoption of the present project, is $100,293.45, resulting in a channel 50 feet wide, with a least depth of 7 feet. During the fiscal year ending June 30, 1881, the expenditures were $10,207.93, and were applied to the removal of rock by drilling, blasting, and dredging in the river bed, 10,980 cubic yards being removed, of which 6,400 cubic yards were utilized for crib filling at adjacent harbors; 1,385 cubic yards of sand were also dredged from the channel. Further operations will be suspended until sufficient funds have been appropriated to permit of an economical continuation of the work.

This harbor is not considered open to commerce, although it is used by small vessels. The commerce of the place is reported as rapidly increasing, and the destruction in October, 1880, of a large portion of the bridge pier has deprived the inhabitants of the facilities afforded by the landing of steamers. Under the circumstances, private enterprise cannot be expected to rebuild the pier, and thus the very improvement being carried on by the government proves, in its unfinished condition, an actual injury to commerce. A memorial from the citizens, and the recommendation of the officer in charge, urge the speedy completion of the harbor. The appropriation asked for will be applied first to pier extension, and then to further removal of the rocky bed of the harbor.

July 1, 1880, amount available	$9,706 55	
Miscellaneous receipts	20 00	
Amount appropriated by act approved March 3, 1881	8,000 00	
		$17,726 55
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		10,207 93
July 1, 1881, amount available		7,518 62
Amount (estimated) required for completion of existing project		57,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		30,000 00

(See Appendix E E 10.)

11. *Kewaunee Harbor, Wisconsin.*—By the act of June 14, 1880, a survey of this harbor was ordered, and an Engineer officer was directed to be assigned as consulting engineer, in the expenditure of funds raised by local taxation. The sum of $8,000 was so raised, which, with $5,000 appropriated by the act of March 3, 1881, is being expended this season on pier extension. The report on the survey was published as House Ex. Doc. No. 51, Forty-sixth Congress, third session.

The estimated cost of the improvement is $200,000, and the object is to obtain a channel with a least depth of 12 feet from deep water to the river, including piers from the shore line to the 18-foot curve. The expenditure during the fiscal year ending June 30, 1881, was $221.75, the work being just commenced. The commercial requirements of the harbor are reported as justifying a sufficiently large appropriation to permit of an economical commencement of work.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	221 75
July 1, 1881, amount available	4,778 25
Amount (estimated) required for completion of existing project	187,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	50,000 00

(See Appendix E E 11.)

12. *Two Rivers Harbor, Wisconsin.*—The present project for the improvement of this harbor was adopted in 1870, and modified in 1877, the object being to afford a channel of navigable width, and of not less than 12 feet in depth, including piers to the 18-foot curve. The natural channel was narrow, with a least depth of about 2 feet. The officer in charge proposes, on account of the limited commerce of the place, which is entirely local, and decreasing, to further modify the project by stopping the piers at the 15-foot curve, and dredging to a depth of 12 feet; this will give a channel which can be maintained at a depth of at least 10 feet, which is but 1 foot less than now possessed by the important harbors of Manitowoc and Sheboygan, Wis.; and will result in a saving of $45,588.80.

The amount expended to June 30, 1880, was $132,539.62, resulting in a channel of 100 feet wide, with a least depth of 7 feet on the bar and 9 feet in the river. During the fiscal year ending June 30, 1881, there was expended the sum of $21,192.42, including outstanding liabilities at that date, ten cribs were built, fifteen sunk and three more were in course of construction at the end of the fiscal year. During the present season these three cribs will be finished and sunk, with another, which was built and ready to sink on June 30, and two more under contract, and superstructure will be built over ten cribs. This will leave but two more cribs to be sunk under the modified project proposed.

The appropriation asked for will be applied during the fiscal year 1882-'83, to pier extension, repairs of piers, and dredging out of the channel.

July 1, 1880, amount available	$27,460 38	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$42,460 38
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	20,087 41	
July 1, 1881, outstanding liabilities	1,105 01	
		21,192 42
July 1, 1881, amount available		21,267 96
Amount (estimated) required for completion of the existing project		90,588 80
Amount that can be profitably expended in fiscal year ending June 30, 1883		50,000 00

(See Appendix E E 12.)

13. *Manitowoc Harbor, Wisconsin.*—The present project for the improvement of this harbor was adopted in 1866. and modified in 1872, the object being to afford a channel of navigable width, with a least depth of 12 feet, including piers to the 18-foot curve. An extension of the project to the amount of $60,000 is required by the lowering of the plane of reference, as mentioned under Green Bay Harbor, and by the proposed carrying of the piers to the 18½-foot curve referred to, the new datum plane.

The expenditures to June 30, 1880, under the present project, amounted to $228,117.49, resulting in a channel 150 feet wide, with a least depth of 11 feet. During the fiscal year ending June 30, 1881, the sum of $10,589.80 was expended in placing four cribs in extension of the piers, repairs, and filling with stone. During the present season superstructure will be built over these four cribs and three others, completing the piers to the 17½-foot curve referred to, the new datum plane.

The appropriation of $50,000 asked will be applied to pier extension and dredging to such a depth as will leave a channel of 13 feet water at the shore line and 18 feet at the entrance. This harbor is an important one, and the commercial requirements fully justify the proposed additional expenditure.

July 1, 1880, amount available	$11,702 51	
Amount appropriated by act approved March 3, 1881	4,000 00	
		$15,702 51
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		10,589 80
July 1, 1881, amount available		5,112 71
Amount (estimated) required for completion of existing project		64,362 54
Amount that can be profitably expended in fiscal year ending June 30, 1883.		50,000 00

(See Appendix E E 13.)

14. *Sheboygan Harbor*, *Wisconsin*.—The original project for the improvement of this harbor was completed within the amount estimated. The present project was made in 1881, and submitted to Congress at its last session. It provides for extension of the piers to the 20-foot curve, with dredging to a depth of 18 feet along the extension, and to 16 feet for the rest of the distance outside the shore line. This is expected to secure a channel with a least depth of 14 feet. The act of March 3, 1881, appropriated $25,000 for this work, which is now being applied to pier extension, and will be entirely expended, it is expected, by November 30, 1881.

During the past fiscal year the sum of $3,128.27 was expended, mainly on dredging a channel across the bar, which had reformed outside the pier-heads, and reduced the depth of water to less than 11 feet. A detailed survey was also made, forming the basis of the new project mentioned above.

The appropriation of $90,000 asked for will, if granted, be applied in the fiscal year 1882–'83 to further pier extension and dredging.

Great difficulty has been experienced in obtaining dredges to work to advantage at this and other harbors in the vicinity, the local dredges being of small capacity and low power, and unable to work outside the shore line, except at a rate which is ruinously expensive. The officer in charge earnestly recommends the building of another dredge by the United States, at a cost of about $30,000, to be paid for by the appropriations for the harbors at Sheboygan, Manitowoc, Sturgeon Bay, and Kewaunee, Wis., at which harbors, there are about 530,000 cubic yards of material to be dredged, equal to 9 years' steady work; and with the same measure of success which has attended the operations of the dredge now owned by the United States in the same district the cost of the new dredge will be saved twice over during the accomplishment of the work.

July 1, 1880, amount available	$9,307 10	
Amount appropriated by act approved March 3, 1881	25,000 00	
		$34,307 10
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		3,128 27
July 1, 1881, amount available		31,178 83
Amount (estimated) required for completion of existing project		125,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		90,000 00

(See Appendix E E 14.)

15. *Port Washington Harbor*, *Wisconsin*.—The present project for the improvement of this harbor was adopted in 1869, and modified in 1870 and 1876, the object of the improvement being to afford a channel of

navigable width, with interior basins, having a least depth of 12 feet, including piers to the 14-foot curve. The natural channel was narrow, with not more than 1 foot in depth at the shoalest point.

The estimate has been increased $27,000, by the adoption of the lower plane of reference, previously mentioned.

The expenditures to June 30, 1880, aggregated $100,496.22, resulting in obtaining a channel 50 feet wide, with a least depth of 5 feet, and 2 basins, having a combined area of 5¾ acres and a depth of from 8 to 10 feet. During the fiscal year ending June 30, 1880, there was expended, including outstanding liabilities on that date, the sum of $5,941.85 on pier extension, three cribs being sunk. On June 30, 12 cribs were under contract, to be all sunk this season. Dredging in the channel will also be done by the United States dredge. At the close of the season of 1881, the piers are expected to be in 12 feet water, referred to the new datum plane, and a 12-foot channel will be opened for half the width between the piers, thus practically opening the harbor to commerce.

The appropriation of 40,000 asked is proposed to be applied during the fiscal year 1882–'83 to the further extension of the piers and dredging. The sum of $5,000 is proposed to be transferred from this harbor to Two Rivers Harbor, to repay the latter for the services of the United States dredge, which has been largely used at Port Washington Harbor, though built by the appropriations for Two Rivers and Ahnepee.

July 1, 1880, amount available	$20,003 78	
Amount appropriated by act approved March 3, 1881	17,000 00	
		$37,003 78
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	5,493 14	
July 1, 1881, outstanding liabilities	448 71	
		5,941 85
July 1, 1881, amount available		31,061 93
Amount (estimated) required for completion of existing project		44,027 17
Amount that can be profitably expended in fiscal year ending June 30, 1883.		40,000 00

(See Appendix E E 15.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with provisions of the river and harbor act of June 14, 1880, Major Robert was charged with and has completed the following survey, the results of which were transmitted to Congress, and printed in House Ex. Doc. No. 51, Forty-sixth Congress, third session.

For a harbor on Lake Michigan, at Kewaunee, Wisconsin. (See also Appendix E E 11.)

And to comply with provisions of the river and harbor act of March 3, 1881, he was charged with an examination at—

1. *Harbor at mouth of Cedar River on Green Bay, Michigan.*
2. *Mouth of Cedar River, Green Bay, Michigan.*

The results of these examinations will be duly submitted when received.

CONSTRUCTION OF HARBOR OF REFUGE, MILWAUKEE BAY—IMPROVEMENT OF THE HARBORS OF MILWAUKEE, RACINE, KENOSHA, AND WAUKEGAN, LAKE MICHIGAN—IMPROVEMENT OF FOX AND WISCONSIN RIVERS.

Officer in charge, Maj. D. C. Houston, Corps of Engineers, with Capt. F. A. Hinman, Corps of Engineers, under his immediate orders.

1. *Harbor of Refuge, Milwaukee Bay, Wisconsin.*—In pursuance of the river and harbor act of June 14, 1880, an examination was made of "the bayou south of Milwaukee Harbor for additional purposes of a harbor of refuge at Milwaukee; also Milwaukee Bay." The results of this examination are published in House Ex. Doc. No. 43, Forty-sixth Congress, third session. The river and harbor act approved March 3, 1881, appropriated $100,000 for "improving Milwaukee Bay for purposes of a harbor of refuge." A Board of Engineers was convened at Milwaukee on the 20th of April, 1881, to consider and report on the plans for a harbor of refuge in Milwaukee Bay. The Board recommended the following tracé for a breakwater to inclose a portion of the bay:

> Starting from near north point, in 8 feet of water, but leaving a gap of about 600 feet between the beginning of the breakwater and the shore to be closed hereafter, if found necessary; the north arm runs for 2,400 feet about south 25 degrees east. The main arm then runs south 11 degrees west for 5,200 feet; 1,000 feet south from the angle an opening 400 feet wide is left for a fair-weather entrance and exit. The southern end of the main arm is at a distance of about 4,150 feet from the present end of the north pier. Should it be found, when the main arm of the breakwater has been completed, that increased protection of the interior of the harbor of refuge against southeast gales is advisable, it is proposed to secure it, either by extending this main arm until it intersects the prolongation of the north pier, or by putting in a covering breakwater, in the position indicated on the tracing, and nearly closing the interval between the south end of the main breakwater and the north river pier, but leaving an entrance of about 1,000 feet at the south end of the main arm.

The report of the Board was approved by the Secretary of War.

It is expected to construct under the appropriation of March 3, 1881, about 1,600 feet of the north arm of the breakwater, commencing at the starting point, up to about 1 foot above the lake level.

There can be profitably expended during the year ending June 30, 1883, the sum of $300,000, assuming that the work is to be completed in four years from the time of commencement.

The amount estimated for the entire and permanent completion of the work, in addition to amount appropriated, is $700,000.

Amount appropriated by act approved March 3, 1881	$100,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	172 20
July 1, 1881, amount available	99,827 80
Amount (estimated) required for completion of existing project	700,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	300,000 00

(See Appendix F F 1.)

2. *Milwaukee Harbor, Wisconsin.*—The original depth of water at the entrance to this harbor was at times not more than $3\frac{1}{2}$ feet and the principal commerce of the port was conducted from wharves in the open lake. The present plan of improvement was adopted in 1852, and consisted originally in cutting a channel from the river to the lake, known as the "north cut," and the construction of parallel piers for its protection, so as to give a navigable depth of 12 feet. Since then the piers have been extended and the channel deepened so that there is now a channel 18 feet deep and of sufficient width. There was expended on this harbor up to June 30, 1880, by the United States $255,987.45, in addition to $321,355.66 expended by the city of Milwaukee, with the results above stated. There has been expended during the year ending June 30, 1881, $8,942.51 in widening the channel, to a depth of 18 feet, from 100 feet to 200 feet.

The unusually heavy spring freshets of this year have had the effect to deepen this channel, and also to narrow it, so that there is now a channel 125 feet wide over 18 feet deep, and 170 feet wide over 15 feet deep.

The appropriation of $8,000 made by the river and harbor act approved March 3, 1881, will be applied to repairs of piers, and such dredging as may be necessary.

It is estimated that an average annual expenditure of $10,000 will be required for the maintenance of this harbor, to be applied to pier extension, protection, repairs, and dredging.

July 1, 1880, amount available	$10,860 72	
Amount appropriated by act approved March 3, 1881	8,000 00	
		$18,860 72
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		7,541 61
July 1, 1881, amount available		11,319 11
Amount (estimated) required for completion of existing project		10,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		10,000 00

(See Appendix F F 2.)

3. *Racine Harbor, Wisconsin.*—The original depth of water at the entrance to this harbor was not more than 6 feet at any time, generally less, and at times the entrance was entirely closed. The present plan of improvement was adopted in 1843, and consisted originally in the construction of parallel piers at the river mouth, and dredging between them so as to obtain a navigable channel of 12 feet. The piers have been continually extended to exclude the drift along the shore, and to provide for deepening the channel to 15 feet or more. There was expended on this harbor up to June 30, 1880, $197,185, resulting in a channel, not less than 15 feet in depth for a width of 50 feet, and not less than 11 feet for a width of 100 feet.

The sum expended during the year ending June 30, 1881, was applied to extension of the north pier.

The appropriation of $6,000 made by the river and harbor act approved March 3, 1881, will be applied to building superstructure over 100 feet of the north pier extended in 1879 and 1880, and in dredging between the piers, the channel having shoaled up for a short distance to 11 feet.

It is proposed to apply the amount asked for the year ending June 30, 1883, to pier extension, repairs, and dredging. The pier extension will prevent the formation of shoals at the mouth of the harbor, and reduce the sea between the piers, which is to some extent the cause of the shoaling which annually occurs. It is estimated that if an appropriation of $16,000 is made for this harbor at the next session of Congress, an average annual expenditure of $8,000 will be required for its maintenance, to be applied to pier extensions, protections, repairs, and dredging.

July 1, 1880, amount available	$6,854 22	
Amount appropriated by act approved March 3, 1881	6,000 00	
		$12,854 22
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		6,860 15
July 1, 1881, amount available		5,994 07
Amount (estimated) required for completion of existing project		16,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		16,000 00

(See Appendix F F 3.)

4. *Kenosha Harbor, Wisconsin.*—The original depth of water at the entrance to this harbor never exceeded 4 feet, and the entrance was entirely closed by northeast storms. The present plan of improvement consisted in the construction of two parallel piers at the river mouth, and dredging between them so as to obtain a navigable depth of 12 feet. Since then it has been expected to obtain a depth of 15 feet or more, by extending the piers and dredging. There was expended on this harbor up to June 30, 1880, $194,307.41, resulting in a navigable channel with a depth not less than 11½ feet. The sum expended during the year ending June 30, 1881, was applied to extending the north pier 50 feet. The city of Kenosha employed a dredge for a short time and a navigable channel of 12½ feet has been maintained.

The appropriation of $5,000 made by the river and harbor act approved March 3, 1881, will be applied to further extension of the north pier.

There can be profitably expended during the year ending June 30, 1883, the sum of $17,000. It is proposed to apply the sum asked for, for the fiscal year 1882-'83 to pier extension, repairs, and dredging.

The pier extension is necessary to secure the desired depth at the mouth of the harbor. Periodical dredging between the piers is necessary at this as at other lake harbors. It is estimated that if an appropriation of $17,000 is made for this harbor at the next session of Congress, an average annual expenditure of $8,000 will be required for its maintenance, to be applied to pier extensions, protections, repairs, and dredging.

July 1, 1880, amount available	$6,646 16	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$11,646 16
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		5,964 11
July 1, 1881, amount available		5,682 05
Amount (estimated) required for completion of existing project		57,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		17,000 00

(See Appendix F F 4.)

5. *Waukegan Harbor, Illinois.*—An appropriation of $15,000 was made for this harbor by the river and harbor act approved June 14, 1880, which provided:

> That this sum shall not be expended until a Board of three Engineers shall have convened and selected the site, and until the same and a free right of way to all points of the harbor shall have been transferred or relinquished, free of cost, to the United States.

Another appropriation of $15,000 was made by the act of March 3, 1881.

The site of the harbor was selected by a Board of Engineers in July, 1880, and transferred to the United States, by the city of Waukegan, by deed dated August 24, 1880. The title, however, was not perfected until May 5, 1881, so that work could not be commenced under the appropriation of June 14, 1880. The Attorney-General of the United States having given an opinion that the United States now hold a valid title to the land conveyed to the government for harbor purposes, a contract was made with Knapp & Gillen, of Racine, dated June 27, 1881, to commence work on the harbor, in accordance with the approved plans. There is now no harbor whatever at this locality. All the lake commerce has been conducted from bridge piers extending into the lake. The plan adopted is to inclose a small basin by projecting piers into the lake in such a manner as to protect vessels while in port. This is proposed to be done by two pile-piers, located as follows: The north pier commences at a point, on the lake shore about 2,370 feet north of the present bridge pier, and extends about 300 feet into the lake; thence south 1,650 feet; thence southeast 142 feet; thence east 300 feet. The south pier commences at a point on the lake shore about 240 feet north of the bridge pier and runs easterly about 900 feet. The area between the piers and the shore is to be dredged to a depth of not less than 12 feet, and the shore line revetted. The work proposed to be done this season is on the north pier, extending about 300 feet into the lake, and thence south about 600 feet.

The amount asked for the fiscal year ending June 30, 1883, will, if granted, be applied in carrying out the plan above described.

The original estimate for completing this work, made in 1879 and based upon the prices of materials and labor at that time, was $110,000. Prices have greatly advanced, and if only small annual appropriations are made, which also increase the cost, the above estimate will doubtless be exceeded.

July 1, 1880, amounted available	$15,000 00	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$30,000 00
July 1, 1881, amounted expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		636 37
July 1, 1881, amount available		29,363 63
Amount (estimated) required for completion of existing project		80,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		50,000 00

(See Appendix F F 5.)

6. *Fox and Wisconsin rivers.*—The improvements on the Fox River, consisting principally of 22 locks, 11 dams, and 7½ miles of canal, were purchased in 1872 of the Green Bay & Mississippi Canal Company. The locks and dams were of a temporary character, except one lock, and generally in bad condition. Navigation was practically stopped on the Lower Fox and suspended on the Upper Fox in low-water. The plan of improvement was to rebuild all of the locks and dams, making the locks of masonry, and the dams either of masonry or of crib-work, filled with stone. This was almost equivalent to an *entire new work.* There have been constructed 11 new locks of masonry, 6 of which replace 7 old ones, and 5 are additional; 12 new dams have been built, 7 replacing old ones. A new retaining-wall of solid masonry, 800 feet long and 21 feet high, for the canal at Appleton has been completed; the canal at Portage, 2¼ miles long, connecting the two rivers, has been deepened to 6 feet and widened to 75 feet; all the old locks have been put in as good order as possible; 12 cut-offs have been made, with a total length of about 5½ miles; over 1,500,000 cubic yards of material have been dredged from the channels, canals, and cut-offs; the canal banks have been raised and strengthened; 5 dwellings built for lock-tenders, &c. The result of these works is that the Fox River is navigated throughout the year by steamboats.

The amount expended on the improvement of the Fox and Wisconsin rivers up to June 20, 1880, is $1,990,273.20. In 1874 a revised estimate was made for completing this work, according to plans adopted, amounting to $3,599,105. Since then $1,420,000 has been appropriated, leaving for completion $2,179,105. An additional estimate for canal at mouth of Lake Winnebago was made in annual report of 1876 of

$146,558, increasing the above to $2,325,663. There has been expended during the year ending June 30, 1881:

On the Fox River	$85,061 07
On the Wisconsin River	58,676 17
Total	143,737 24

The results of the expenditures will not be manifest until the work is completed, although, as above stated, navigation over a large portion of the line has been greatly improved. The foregoing estimates were made on the supposition that adequate appropriations would be made. The appropriations for the past five years have been entirely inadequate for a work of this magnitude. Those for the past two years, $125,000, would not be much more than sufficient for the annual maintenance of the work, if it were completed; of the $125,000, but $75,000 was available for the Fox. Deducting the cost of dredging operations and necessary cost of repairs of old work, there is not sufficient to warrant the construction of new work. Some of the old locks are in bad condition and liable to become unserviceable, which would destroy existing navigation. If they could all be replaced with masonry locks the cost of maintenance would be greatly reduced.

There can be profitably expended during the year ending June 30, 1883, the sum of $500,000 in carrying out the project.

On the Wisconsin River there was no navigation at low-water, owing to sand-bars. One hundred and ninety-eight dams of brush and stone, with a total length of 95,992 feet, have been built. These are distributed over about 50 miles of the river. The object of these dams is to reduce the width of the river, so as to concentrate the force of the current in a narrow channel and increase the depth by scouring out the sand which constitutes the bed of the stream. Wherever the channel has been sufficiently contracted, an increased depth has resulted. During the past year the channel has been contracted continuously to a width of 300 feet at low-water for a distance of 7 miles below Portage, as recommended by the Board of Engineers. About 4 miles of this was done in 1880, and gave a 4-foot channel at the lowest stage of the season. This continuous contraction will be continued for a distance of 12 miles below Portage.

The following work remains to be done to complete the improvement on the Fox River:

On the Lower Fox.—Rebuilding 10 locks and 1 dam; deepening channel to 6 feet; constructing guard gates at heads of canals at Menasha, Appleton, Kaukauna, Rapid Croche, and Little Kaukauna; constructing waste weirs in dams at Menasha and Kaukauna; lengthening Rapid Croche lock; building lock-tenders' dwellings; strengthening and paving canal banks.

On the Upper Fox.—Rebuilding 4 locks at Portage, Governor's Bend and Montello, and 2 dams at Governor's Bend and Montello; widening canals at Berlin, White River, Princeton and Grand River, and protecting their banks; protecting river banks where they are liable to wash; dredging channel of river to 6 feet in depth and 100 feet in width, and placing buoys to mark channel; building lock-tenders' houses.

On the Wisconsin River.—About 300,000 feet of wing-dams.

It is proposed to apply the funds now available and estimated for the year ending June 30, 1883, to continuing the work in accordance with the plans adopted.

July 1, 1880, amount available	$174,623 77	
Tolls received and deposited to credit of appropriation	2,461 54	
Miscellaneous receipts	193 50	
Amount appropriated by act approved March 3, 1881	125,000 00	
		$302,278 81
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		143,737 24
July 1, 1881, amount available		158,541 57
Amount (estimated) required for completion of existing project		2,325,663 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		500,000 00

(See Appendix F F 6.)

IMPROVEMENT OF THE HARBORS OF CHICAGO AND CALUMET, LAKE MICHIGAN—IMPROVEMENT OF ILLINOIS RIVER.

Officer in charge Maj. G. J. Lydecker, Corps of Engineers.

1. *Chicago Harbor, Illinois.*—The present project for the improvement of this harbor was adopted in 1870, and modified in 1878, the original object being to provide an outer harbor, and thereby relieve the overcrowded state of the Chicago River, and afford a limited refuge for vessels in heavy weather; the modified project gives cover to a greater extent of shore line, extends the area of sheltered space in the harbor, and provides for the construction of an exterior breakwater to facilitate entrance to the harbor, and afford a harbor of refuge in deep water.

The amount expended since 1870, in the execution of this project is $731,144.44, and has resulted in the construction of 8,200 linear feet of piers and breakwaters that comprise the sheltering elements of outer harbor, in the partial dredging of the outer harbor, affording a wide channel through it 16 feet deep, and in the construction of 1,000 linear feet of cribs that will be used in the exterior breakwater. The money appropriated by the act of March 3, 1881, viz, $150,000, will be applied to continuing work on the exterior breakwater.

The appropriation of $350,000 asked for the fiscal year ending June 30, 1883, is necessary for continuing the work now in progress, viz, dredging the outer harbor and constructing the exterior breakwater. This structure will be 5,436 feet long when completed; its location is across the track of vessels approaching the harbor, and having been commenced, it is a matter of the gravest importance to their safety that it be completed at the earliest date practicable; until entirely finished and properly lighted, it will be a constant danger to navigation, and it is therefore urged that the full amount asked for be appropriated. As indicating the magnitude of the work, and the importance of having ample means for its prosecution, it should be noted that cribs used are 100 feet long, 30 feet wide, and average 30 feet in depth when sunk; the amount of stone required to fill one such crib is 400 cords (over 20,000 tons), and the safety of the work requires that each crib be completely filled within the shortest possible time after it is sunk, in order to prevent its destruction in the event of a storm arising before this is accomplished.

July 1, 1880, amount available	$166,291 96	
Amount appropriated by act approved March 3, 1881	150,000 00	
		$316,291 96
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	58,637 99	
July 1, 1881, outstanding liabilities	9,628 22	
		68,266 21
July 1, 1881, amount available		248,025 75

Amount (estimated) required for completion of existing project	$430,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	350,000,00

(See Appendix G G 1.)

2. *Calumet Harbor, Illinois.*—The present project for the improvement of this harbor has for its object the creation and maintenance of a channel 300 feet wide and 16 feet deep, from Lake Michigan to Calumet River. As originally projected, the depth was to be 13½ feet, the increase to 16 feet having become necessary to accommodate the larger class of vessels now frequenting the harbor, and which draw, when loaded, 15 feet. The natural channel over the bar at the mouth of the river was narrow, crooked, and unreliable, varying in depth from 4 to 7 feet.

The amount expended to June 30, 1881, is $296,797.03, and has resulted in securing a narrow channel 13 feet deep at low-water. This has been accomplished by dredging 298,548 cubic yards, and constructing 4,710 linear feet of piers for the protection of the channel-way between them.

The appropriation of $35,000 asked for is to be applied to completing the channel between the piers to its full width, and to extending the north pier far enough to prevent any bar formation at the entrance; this amount will suffice to complete the present project, and its immediate completion is a matter of importance, in view of the rapidly growing commercial interests of the port.

July 1, 1880, amount available	$20,708 16	
Amount appropriated by act approved March 3, 1881	30,000 00	
		$50,708 16
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		20,505 19
July 1, 1881, amount available		30,202 97
Amount (estimated) required for completion of existing project		35,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		35,000 00

(See Appendix G G 2.)

3. *Illinois River.*—From 1869 to 1880 the improvement of this river, so far as carried on by the general government, consisted chiefly in dredging channels through the worst bars and the construction of wing-dams and dikes to assist in maintaining them by contracting the general water-way; this work was designed to afford a temporary relief to navigation, and ultimately constitute a part of the radical improvement of the river by the slackwater system; the amount expended in that way to June 30, 1880, was $550,450.55, and resulted in giving channels, with a navigable depth of from 3 to 4 feet, through the worst bars, the aggregate length of dredged channels being about 24 miles; these channels were not permanent, and at low-water stages boats could not go through with a draft exceeding 30 inches. Prior to any improvement the natural channels were, as a rule, narrow, crooked, and shifting, and low-water navigation was limited to a draft of about 18 inches.

A radical improvement, extending 90 miles below the head of navigation at La Salle (where the Illinois and Michigan Canal enters the river), has been effected by the State of Illinois by the construction of two locks, creating a slackwater navigation adapted to a navigable depth of 6 feet at extreme low-water. The present project contemplates the extension of this system of improvement, 100 miles further down, which will bring it nearly to the mouth of the river. This is to be accomplished by the construction of two locks, that part of the river between the lowest lock and the mouth being given the same navigable depth by dredging. Preliminary work on this project was commenced during the past fiscal year, the amount expended in its execution being $34,471.77. Arrangements are now complete for an energetic prosecution of the work, and the $250,000 appropriated by the act of March 3, 1881, will be applied to this object. The appropriation of $380,000 asked for the fiscal year ending June 30, 1883, is to be applied to this object, the entire amount being considered essential to a satisfactory progress on the works of construction and to making the ultimate cost of the completed improvement a minimum. Of this amount, at least $25,000 will be required for operating the dredging outfit, which is owned by the government and was especially provided for works on this river.

July 1, 1880, amount available	$148,337 81	
Amount appropriated by act approved March 3, 1881	250,000 00	
		$398,337 81
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	25,416 37	
July 1, 1881, outstanding liabilities	9,055 40	
		34,471 77
July 1, 1881, amount available		363,866 04
Amount (estimated) required for completion of existing project		552,512 19
Amount that can be profitably expended in fiscal year ending June 30, 1883		380,000 00

(See Appendix G G 3.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with the requirements of the river and harbor act of June 14, 1880, Major Lydecker was charged with and has completed the following, the results of which were transmitted to Congress at its last session:

1. *Chicago River from its mouth to the junction of the North and South Branches.*
2. *That part of the North Branch of Chicago River lying in the town of Lake View.*

(See Appendix G G 1.)

And to comply with the river and harbor act of March 3, 1881, he is charged with the following, the results of which will be duly submitted when received:

1. *The Calumet River from South Chicago to the village of Pullman, on Lake Calumet.*

IMPROVEMENT OF THE HARBORS OF MICHIGAN CITY AND NEW BUFFALO, LAKE MICHIGAN.

Officer in charge, Maj. Jared A. Smith, Corps of Engineers.

1. *Harbor at Michigan City, Indiana—Outer Harbor.*—The plan of the harbor was modified in July, 1880, by a Board of Engineers convened to consider the project for improvement.

As modified, the entrance to the outer harbor will be greatly facilitated, and the inner harbor will be in a great measure relieved from the effects of the heavy seas which have heretofore caused great annoyance to shipping.

The modification of the plan consists in placing the entrance at the northwest angle, with two parallel piers 300 feet apart, instead of the northeast angle, as first adopted.

During the year the breakwater has been extended eastward 150 linear feet.

The foundation piles for a further extension of 150 feet have been driven, and three cribs are in readiness for sinking.

The channel entrance to the inner harbor having shoaled somewhat, it became necessary to deepen it by dredging, to permit towing the cribs to the breakwater.

Five thousand nine hundred and twenty-four cubic yards of material were removed from the shoal, and dumped in the lake.

The harbor at this place was originally simply the mouth of a creek, which was generally obstructed by sand-bars.

A project for its improvement with special reference to making it a harbor of refuge was adopted in 1870.

The improvements thus far are such as to enable vessels of the largest class now on the lakes to enter at all times; and, while formerly there was no regular commerce 762 loaded vessels entered and 769 left the port during the last year.

The entrance is sufficiently deep for all ordinary purposes, but the absence of piers and the incomplete condition of the breakwater, permits the formation of currents which, in storms, are so strong as to cause difficulty in entering with sail vessels. Several vessels have, from this cause, missed the entrance and been wrecked upon the shore. The necessity for an appropriation sufficiently large for the completion of the breakwater and entrance piers during the next year is urgent.

Since the harbor furnishes no anchorage, owing to shallow water in the basin, the necessity for dredging at once is apparent.

The officer in charge recommends, for the reason that it would be much more economical, that an appropriation of $20,000 be made for building a dredge, in addition to the appropriation for the work.

There has beeen expended to June 30, 1881, including outstanding liabilities, the sum of $359,798.33.

The amount required to complete the work according to present project is $190,000.

Of this amount $100,000 should be appropriated for the next fiscal year, in addition to the sum asked to build a dredge.

It is proposed to use this amount, if granted, in completing the breakwater and the piers to protect the entrance; in building a dredge and commencing the deepening of the basin for anchorage.

July 1, 1880, amount available	$44,342 11	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$64,342 11
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	34,337 67	
July 1, 1881, outstanding liabilities	1,675 76	
		36,013 43
July 1, 1881, amount available		28,328 68
Amount (estimated) required for completion of existing project		190,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		120,000 00

Inner Harbor.—The channel has been extended to full width to Market street. The cuts on west side have been extended to Division street, and on east side 100 feet south of Miller street.

The government dredge worked five months and removed 58,224 cubic yards in extending the harbor, and 1,770 cubic yards in removing bars.

The dredge being old and worn out, was rebuilt during the winter.

A contract has been made for dredging 60,000 cubic yards the ensuing year.

The work thus far done has resulted in more than doubling the commerce of the place in the last four years. Its lumber market is now only second to that of Chicago.

There has been expended on this improvement to June 30, 1881, including liabilities, the sum of $36,064.74.

The present project contemplates extending the improvement a distance of half a mile.

The officer in charge estimates that the sum asked for will complete the work in accordance with the plan submitted in last annual report.

July 1, 1880, amount available	$15,000 00	
Amount appropriated by act approved March 3, 1881	25,000 00	
		$40,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	10,278 59	
July 1, 1881, outstanding liabilites	786 15	
		11,064 74
July 1, 1881, amount available		28,935 26
Amount (estimated) required for completion of existing project		50,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		50,000 00

(See Appendix H H 1.)

2. *Harbor at New Buffalo, Michigan.*—No work of improvement was undertaken at this place during the year.

The act of March 3, 1881, required a survey for a harbor of refuge, which was made from a balance remaining of former appropriation for the work. A full report with estimates of cost will be submitted as soon as the notes can be reduced and plotted.

It is proposed to apply the funds now available, $4,637.59, to repairing the pier constructed by the government.

July 1, 1880, amount available	$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	362 41
July 1, 1881, amount available	4,637 59

(See Appendix H H 2.)

IMPROVEMENT OF HARBORS ON EASTERN SHORE OF LAKE MICHIGAN AND OF GRAND RIVER BELOW GRAND RAPIDS—IMPROVEMENT OF SAGINAW RIVER AND OF CERTAIN HARBORS ON LAKE HURON—CONSTRUCTION OF ICE-HARBOR OF REFUGE AT BELLE RIVER—IMPROVEMENT OF CLINTON RIVER—REPAIR AND PRESERVATION OF SAINT CLAIR FLATS CANAL.

Officer in charge, Maj. Franklin Harwood, Corps of Engineers.

1. *Carlevoix Harbor, Michigan.*—The original channel of entrance to this harbor had an average width of 75 feet, the depth of water varying from 2 to 6 feet.

The present project for its improvement was adopted in 1868, and revised in 1875 and 1876, its object being to dredge a channel 100 or 150 feet wide to a depth of 12 feet, and to protect both sides of it with close piling; this was modified in 1876 by substituting crib work for pile piers.

The amount expended to June 30, 1880, was $30,938.52, and has resulted in securing a channel 100 feet wide between the piers, with a depth of not less than 9 feet 6 inches.

The amount expended during the year ending June 30, 1881, was $5,318.62 which was applied to repairs and completion of piers.

The amount that can be profitably expended during the year ending June 30, 1883, is $20,000, which it is proposed to expend, if appropriated, in completing the dredging of the interior channel to 80 feet in width and 12 feet depth, with channel 100 feet wide between the piers.

The estimated amount required for the entire and permanent completion of the work of improvement, in accordance with the approved and adopted project, is $135,000.

July 1, 1880, amount available	$10,061 48	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$20,061 48
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,073 99	
July 1, 1881, outstanding liabilities	1,244 63	
		5,318 62
July 1, 1881, amount available		14,742 86
Amount (estimated) required for completion of existing project		135,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		20,000 00

(See Appendix I I 1.)

2. *Frankfort Harbor, Michigan.*—The natural channel of entrance to this harbor was not more than from 3 to 4 feet in depth. The present project for its improvement was adopted in 1866, the object being to dredge a new outlet through a strip of land which separated Lake Aux Becs Scies from Lake Michigan, and the building of two parallel piers, to extend from 12 feet soundings in the inner lake to the same depth in Lake Michigan, with a width of 200 feet between the piers.

The amount expended to June 30, 1880, was $213,069.21, resulting in securing a channel 75 feet wide, with a depth of not less than 12 feet.

The amount expended during the year ending June 30, 1881, was $5,162.45, and has resulted in restoring the channel above mentioned which was filled in from the channel banks.

The amount that can be profitably expended during the year ending June 30, 1883, is $40,000, which, if appropriated, it is proposed to expend in completing the channel of entrance.

The estimated amount required for the entire and permanent completion of the work of improvement, in accordance with the approved and adopted project, is $100,000.

July 1, 1880, amount available	$5,590 64	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$15,590 64
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	5,042 45	
July 1, 1881, outstanding liabilities	120 00	
		5,162 45
July 1, 1881, amount available		10,428 19
Amount (estimated) required for completion of existing project		100,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		40,000 00

(See Appendix I I 2.)

3. *Harbor of Refuge at Portage Lake, Lake Michigan.*—At this harbor no natural channel existed previous to the beginning of the improvement.

The project for improvement was adopted in 1879, the object being to make it a harbor of refuge and to afford a channel of a navigable width of 300 feet, and not less than 18 feet deep. The amount expended to June 30, 1880, was $8,954.14, and resulted in securing a channel 50 feet wide, with a depth of not less than 6 feet.

The amount expended during the year ending June 30, 1881, was $8,762.48, and has resulted in converting the temporary brush jetties into permanent pile piering, out to 12 feet depth in the lake.

The amount that can be profitably expended during the year ending June 30, 1883, is $100,000, and, if appropriated, it is proposed to expend it in pier extension in furtherance of the approved project.

The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is indeterminate.

July 1, 1880, amount available	$11,045 86	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$21,045 86
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	8,313 61	
July 1, 1881, outstanding liabilities	448 87	
		8,762 48
July 1, 1881, amount available		12,283 38
Amount that can be profitably expended in fiscal year ending June 30, 1883.		100,000 00

(See Appendix I I 3.)

4. *Manistee Harbor, Michigan.*—A narrow channel with not more than 8 feet depth, was afforded at this harbor by the slab piers built by local enterprise. The present project for the improvement was adopted in 1866, and modified in 1870–'74, the object being to afford a channel of entrance of navigable width, and not less than 12 feet deep.

The amount expended to June 30, 1880, was $175,516.20, and has resulted in securing a channel 170 feet wide, with a depth of not less than 9 feet at its shoalest part.

The amount expended during the year ending June 30, 1881, is $9,015.55, and has resulted in adding three cribs, 50 feet in length each, to the north United States pier, and in deepening the channel to 14 feet for a narrow width, to connect with the improved river channel above.

The amount that can be profitably expended during the year ending June 30, 1883, is $40,000, and, if appropriated, it is proposed to expend it in completing the channel to full width and 14 feet depth, and in pier extension.

The estimated amount required for the entire and permanent completion of the improvement, in accordance with the approved and adopted project, is indeterminate.

July 1, 1880, amount available	$17,143 99	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$27,143 99
July 1 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	8,843 68	
July 1, 1881, outstanding liabilities	171 87	
		9,015 55
July 1, 1881, amount available		18,128 44
Amount that can be profitably expended in fiscal year ending June 30, 1883.		40,000 00

(See Appendix I I 4.)

5. *Ludington Harbor, Michigan.*—The channel made by local enterprise at this harbor was narrow, and not more than 7 feet in depth.

The present project for the improvement of this harbor was adopted in 1867, the object being to afford a channel of entrance of navigable width, and not less than 12 feet deep.*

The amount expended to June 30, 1880, was $195,339.51, and resulted in securing a channel about 200 feet wide, with a depth of not less than 10½ feet along the axis.

The amount expended during the year ending June 30, 1881, is $5,277.68, and has resulted in securing the south pier head, endangered by the storm of October 16, 1880, and the channel of entrance from sand leakage through the piers and revetments.

The amount that can be profitably expended during the year ending June 30, 1883, is $35,000, which, if appropriated, it is proposed to apply in general repairs, dredging the channel of entrance to 12 feet depth, and in 200 linear feet of pier extension.

The estimated amount required for the entire and permanent completion of the work of improvement, in accordance with the approved and adopted project, is indeterminate.

July 1, 1880, amount available	$8,283 33	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$18,283 33
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		5,277 68
July 1, 1881, amount available		13,005 65
Amount that can be profitably expended in fiscal year ending June 30, 1883		35,000 00

(See Appendix I I 5.)

6. *Pentwater Harbor, Michigan.*—The original channel at this harbor was narrow, with not more than 4 feet depth in the shoalest part.

The present project for the improvement of the harbor was adopted in 1866, the object being to afford a channel of navigable width and of not less than 12 feet in depth.

The amount expended to June 30, 1880, was $167,680.64, and resulted in securing a channel 150 feet wide and of sufficient depth in mid-channel to accommodate vessels drawing 9 feet of water.

The amount expended during the year ending June 30, 1881, is $4,708.76, and has resulted in securing the channel of entrance from sand encroachments through and over the piers and revetments.

The amount that can be profitably expended during the year ending June 30, 1883, is $35,000, which, if appropriated, it is proposed to expend in completing the dredging of the channel to clear 100 feet width with 12 feet depth, and in 200 feet pier extension.

The estimated amount required for the entire and permanent completion of the work of improvement, in accordance with the approved and adopted project, is indeterminate.

July 1, 1880, amount available	$4,696 76	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$14,696 76
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,218 60	
July 1, 1881, outstanding liabilities	490 16	
		4,708 76
July 1, 1881, amount available		9,988 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		35,000 00

(See Appendix I I 6.)

7. *White River Harbor, Michigan.*—The old channel at this harbor being narrow, tortuous, and too shoal to accommodate any but very small vessels, a new channel was deemed to be necessary.

The present project for the improvement of this harbor was adopted in 1866, the object being to afford a channel of navigable width and of not less than 12 feet in depth.

The amount expended to June 30, 1880, was $197,322.98, and has resulted in securing a channel of varying width, and not less than 8 feet in depth.

The amount expended during the year ending June 30, 1881, is $11,627.28, and has resulted in nearly arresting the shoaling of the channel of entrance by sand-drift through and over the piers and revetments.

The amount of $40,000 can be profitably expended during the year ending June 30, 1883, and, if appropriated, it is proposed to apply it in completing measures to arrest sand-drift, in dredging the channel, and in constructing 200 feet pier extension under the approved project.

The estimated amount required for the entire and permanent completion of the work of improvement, in accordance with the approved and adopted project, is indeterminate.

July 1, 1880, amount available	$10,727 02	
Amount appropriated by act approved March 3, 1881	7,500 00	
		$18,227 02
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	11,202 79	
July 1, 1881, outstanding liabilities	424 49	
		11,627 28
July 1, 1881, amount available		6,599 74
Amount that can be profitably expended in fiscal year ending June 30, 1883.		40,000 00

(See Appendix I I 7.)

8. *Muskegon Harbor, Michigan.*—The original channel at this harbor was irregularly defined by slab-piers, which gave fair access, but a bar just at the pier ends, on which but 7 feet of water was found, obstructed the entrance.

The present project for improvement was adopted in 1866, the object being to afford a channel of entrance of navigable width with the ends of the piers resting in 17 feet soundings over the bar.

The amount expended to June 30, 1880, was $144,583.22, and has resulted in securing a channel 186 feet wide, with an available depth of 13 feet for nearly the entire width.

The amount of $7,628.92 has been expended during the year ending June 30, 1881, and has resulted in securing the channel of entrance from sand-drift, and in keeping the piers in repair.

The amount that can be profitably expended during the year ending June 30, 1883, is $75,000, and it is proposed to apply it, if appropriated, in completing the detached section of the north pier to 17 feet depth of water and extending the south pier to a corresponding distance.

The estimated amount required for the entire and permanent completion of the work of improvement, in accordance with the approved and adopted project, is indeterminate.

July 1, 1880, amount available	$11,941 68	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$31,941 68
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	7,505 42	
July 1, 1881, outstanding liabilities	123 50	
		7,628 92
July 1, 1881, amount available		24,312 76
Amount that can be profitably expended in fiscal year ending June 30, 1883		75,000 00

(See Appendix I I 8.)

9. *Grand Haven Harbor, Michigan.*—The natural outlet to this harbor was wide, but shoal, there being only 9 feet water on the best course.

The present project for the improvement of this harbor was adopted in 1866, the object being to afford a channel of entrance of navigable width and not less than 18 feet depth.

The amount expended to June 30, 1880, was $301,648.66, and has resulted in securing a channel 400 feet wide, with depth varying from 9 to 23 feet.

The amount expended during the year ending June 30, 1881, is $20,175.82, and has resulted in partially securing the inner harbor from sand encroachment.

The amount that can be profitably expended during the year ending June 30, 1883, is $125,000, and, if appropriated, it is proposed to expend it as follows: $100,000 in pier extension, and $25,000 in repairing and rebuilding piers and revetments.

The estimated amount required for the entire and permanent completion of the work of improvement, in accordance with the approved and adopted project, is $300,000.

July 1, 1880, amount available	$50,217 49	
Amount appropriated by act approved March 3, 1881	50,000 00	
		$100,217 49
July 1, 1881, amount expended during fiscal year, exclusive of outstanding libailities July 1, 1880	16,307 19	
July 1, 1881, outstanding liabilities	3,868 63	
		20,175 82
July 1, 1881, amount available		80,041 67
Amount (estimated) required for completion of existing project		300,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		125,000 00

(See Appendix I I 9.)

10. *Grand River, below Grand Rapids, Michigan.*—The portions of channel below Grand Rapids, intended to be improved, have less than 4 feet water at low stage.

The originally adopted project, 1881, is to give relief to light navigation by securing 4 feet depth of water over shoals.

No money has been expended upon the work.

The amount that can be profitably expended during the year ending June 30, 1883, is $15,000.

The estimated amount required for the entire and permanent completion of the work of improvement, in accordance with the approved and adopted project, is $15,000.

Amount appropriated by act approved March 3, 1881	$10,000 00
July 1, 1881, amount available	10,000 00
Amount (estimated) required for completion of existing project	15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	15,000 00

(See Appendix I I 10.)

11. *Black Lake Harbor, Michigan.*—The channel at this harbor, made by the "Harbor Board of the City of Holland," was narrow, irregular, and only 5½ feet in depth.

The present project for improvement was adopted in 1866 and modified in 1873, the object being to afford a channel of entrance of navigable width and not less than 12 feet deep.

The amount expended to June 30, 1880, was $217,615.31, and resulted in securing a navigable channel with a depth of 9 feet midway.

The amount expended during the year ending June 30, 1881, is $7,751.87, and has resulted in partially securing the channel of entrance from sand-drift over and through the piers.

The amount that can be profitably expended during the year ending June 30, 1883, is $25,000, and it is proposed to apply it, if appropriated, in pier repairs and extension or dredging between piers, as may be most necessary when the appropriation becomes available.

The amount estimated to be required for the entire and permanent completion of the work in accordance with the approved and adopted project, is indeterminate.

July 1, 1880, amount available	$6,000 00	
Amount appropriated by act approved March 3, 1881	6,000 00	
		$12,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	6,960 05	
July 1, 1881, outstanding liabilities	791 82	
		7,751 87
July 1, 1881, amount available		4,248 13
Amount that can be profitably expended in fiscal year ending June 30, 1883		25,000 00

(See Appendix I I 11.)

12. *Saugatuck Harbor, Michigan.*—The channel at this harbor was originally made by local enterprise and was narrow, with not more than 7 feet in depth, in the best water.

The present project for improvement was adopted in 1869, the object being to afford a channel of entrance of navigable width, and of not less than 10 feet in depth.

The amount expended to June 30, 1880, was $102,973.59, and resulted in securing a channel of sufficient width, but of only 8 feet depth, and that for but part of the whole width.

The amount expended during the year ending June 30, 1881, was $5,278.29, and has resulted in dredging a navigable channel of 10 feet depth below the lower bend of the river and in partially constructing a revetment designed to preserve this channel.

The amount that can be profitably expended during the year ending June 30, 1883, is $25,000.

The estimated amount required for the entire and permanent completion of the work of improvement is indeterminate.

July 1, 1880, amount available	$7,465 41	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$12,465 41
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,646 11	
July 1, 1881, outstanding liabilities	2,632 18	
		5,278 29
July 1, 1881, amount available		7,187,12
Amount that can be profitably expended in fiscal year ending June 30, 1883		25,000 00

(See Appendix I I 12.)

13. *South Haven Harbor, Michigan.*—The channel at this harbor was originally made by private enterprise and was narrow, with not more than 7 feet depth at the deepest place.

The present project for improvement was adopted in 1866 and modified in 1879, the object being to afford a channel of entrance of navigable width and of not less than 14 feet depth.

The amount expended up to the close of the fiscal year ending June 30, 1880, was $147,319.54, and resulted in securing a navigable channel with an available depth of water of not less than 12 feet midway.

The amount expended during the fiscal year ending June 30, 1881, was $5,160.91, and has resulted in securing a navigable channel with an available depth of water of 14 feet inside the outer bar.

The amount that can be profitably expended during the year ending June 30, 1883, is $25,000, and it is proposed to apply it in pier extension in furtherance of the approved project.

The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is $100,000.

July 1, 1880, amount available	$6,754 88	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$11,754 88
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,319 18	
July 1, 1881, outstanding liabilities	841 73	
		5,160 91
July 1, 1881, amount available		6,593 97

Amount (estimated) required for completion of existing project	100,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	25,000 00

(See Appendix I I 13.)

14. *Saint Joseph Harbor, Michigan.*—The natural channel at this harbor was about 250 feet wide, and 12 feet in depth at the mouth, with 9 feet in the river above.

The present project for improving this harbor was adopted in 1836, and modified in 1866 and 1874, the object being to afford a channel of entrance of navigable width and not less than 16 feet deep.

The amount expended to June 30, 1880, is $120,665.11 (which includes the construction of a wing-dam at the mouth of the Paw Paw River), and resulted in securing a channel 240 feet wide, with a depth of not less than 14 feet between the piers and of 12 feet in the south channel of the old basin.

The amount expended during the year ending June 30, 1881, is $10,006.61, and has resulted in building 1,167 linear feet of plank beam revetment of north bank of Benton Harbor Canal; in dredging 27,137 cubic yards in deepening the canal; in making repairs on the Saint Joseph piers, and extending the north pier by the addition of a crib 50 feet in length.

The amount that can be profitably expended during the year ending June 30, 1883, is $38,000, and if appropriated it is proposed to apply it as follows:

For repairs of piers and catch-sand protections	$5,000 00
For pier extension	25,000 00
Benton Harbor Canal:	
For completing the improvement	8,000 00

The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is indeterminate.

July 1, 1880, amount available	$11,334 89	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$21,334 89
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		10,006 61
July 1, 1881, amount available		11,328 28
Amount that can be profitably expended in fiscal year ending June 30, 1883:		
For Saint Joseph Harbor	30,000 00	
For Benton Harbor, Michigan	8,000 00	
		38,000 00

See Appendix I I 14.)

15. *Cheboygan Harbor, Michigan.*—At this harbor the channel of entrance was originally narrow, with not more than 6½ feet to 7 feet in depth in the shoalest part.

The present project for its improvement was adopted in 1871, the object being to afford a channel from the mouth of the river 200 feet wide and of not less than 14 feet depth.

The amount expended to June 30, 1880, was $90,874.42, and resulted in securing a channel 200 feet wide with a depth of not less than 13 feet.

The amount expended during the year ending June 30, 1881, is $3,603.98, which has resulted in deepening the channel to 15 feet for 50 feet width along its axis for nearly its whole length.

The amount that can be profitably expended during the year ending June 30, 1883, is $20,000, which, if appropriated, it is proposed to expend in completing the dredging for a harbor of 14 feet depth of water.

The estimated amount required for the entire and permanent completion of the work of improvement, in accordance with the approved and adopted project, is $50,000.

July 1, 1880, amount available	$6,125 58	
Amount appropriated by act approved March 3, 1881	6,000 00	
		$12,125 58
July 1 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	3,483 98	
July 1, 1881, outstanding liabilities	120,00	
		3,603 98
July 1, 1881, amount available		8,521 60
Amount (estimated) required for completion of existing project		50,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		20,000 00

(See Appendix I I 15.)

16. *Thunder Bay Harbor, Michigan.*—The depth of the original channel at this harbor varied from time to time from 4 to 7 feet at the shoalest part. It was, however, in 1869, deepened by private enterprise to 11 feet.

The project for its improvement was adopted in 1876, the object being to afford a channel of entrance of navigable width and of not less than 13 feet in depth.

The amount expended to June 30, 1880, was $3,935.36, and has resulted in securing a channel 12 feet in depth.

A survey was made during the fiscal year, upon which to base an estimate for needed improvements, at a cost of $285, and the officer in charge is of opinion that the harbor should be deepened to 14 feet, with a view to affording the requisite facilities for the large and increasing lumber trade, at an estimated cost of $15,000, which sum he recommends be appropriated for the fiscal year ending June 30, 1883.

July 1, 1880, amount available	$564 64
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	285 87
July 1, 1881, amount available	278 77
Amount (estimated) required for completion of existing project	15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	15,000 00

(See Appendix I I 16.)

17. *Harbor and river at Au Sable, Michigan.*—The original channel at the mouth of the river was not more than 5½ feet in depth at the shoalest part.

The present project for the improvement of the harbor was adopted in 1866 and modified in 1879, the object being to afford a channel of entrance of 100 feet in width in the clear, and not less than 10 feet in depth.

The revetment of the banks of the river from the Oscoda Bridge to the United States piers, and the rectification of the angle in the south pier, were completed during the season of 1880, and the channel being confined to a width of from 80 to 100 feet was, by the effect of the spring freshets, scoured to a depth of from 9 to 10 feet. This scouring process in the river, however, resulted in shoaling the bar at its mouth to less than 6 feet, and it became necessary, with a view to encouraging the scouring action of the current, to construct a training wall of piling over the bar and out into the lake to 12 feet water. This work was progressing favorably at the close of the fiscal year. The officer in charge expects in a few more seasons' operations to complete the design originally proposed for a channel of 100 feet width and 10 feet depth.

The amount expended to June 30, 1880, was $37,219.81, and resulted in securing a channel 80 feet wide with a depth of not less than 8 feet.

The amount expended during the year ending June 30, 1881, is $10,322.24, which has resulted in securing a depth in the channel of not less than 9 feet, and generally over 10 feet.

The amount that can be profitably expended during the year ending June 30, 1883, is $12,000, which, if appropriated, it is proposed to expend in securing the improvement effected by the season's work of 1881.

The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is $12,000.

July 1, 1880, amount available	$10,526 65	
Amount appropriated by act approved March 3, 1881	6,000 00	
		$16,526 65
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	10,202 24	
July 1, 1881, outstanding liabilities	120 00	
		10,322 24
July 1, 1881, amount available		6,204 41
Amount (estimated) required for completion of existing project		12,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		12,000 00

(See Appendix I I 17.)

18. *Saginaw River, Michigan.*—The natural channel of this river was tortuous and obstructed by many bars, with not more than 7 feet in depth at the shoalest part.

The present project for the improvement of this river was adopted in 1874, and modified in 1878, the object being to afford a clear depth of not less than 10 feet over the bars in the river.

The amount expended to June 30, 1880, was $81,000, and has resulted in securing a channel not less than 100 feet wide and with a depth of not less than 9 feet.

The amount expended during the year ending June 30, 1881, $8,862.88, was applied to the preservation of the channel at Carrollton Bar, and to surveying with a view to the improvement of the channels at and below Bay City.

The amount that can be profitably expended during the year ending June 30, 1883, is $205,000, which, if appropriated, it is proposed to expend in improving the channels at and below Bay City. The channels above will be estimated for separately.

The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved project is $380,000, exclusive of the upper river improvement.

July 1, 1880, amount available	$15,000 00	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$25,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		8,862 88
July 1, 1881, amount available		16,137 12
Amount (estimated) required for completion of existing project		380,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		205,000 00

(See Appendix I I 18.)

19. *Sebewaing Harbor, Michigan.*—Sebewaing River is a small stream debouching into Saginaw Bay, with originally no channel entrance, excepting for small boats. The original project for the improvement of the harbor at its mouth was adopted in 1875, and completed in 1876, at a cost of $8,000, the object being to afford a channel 100 feet wide and 6 feet deep.

The present project, approved in 1880, is to dredge a channel 500 feet wide and 7 feet deep, which it is hoped to complete by aid of the existing appropriation.

The amount expended to the close of the fiscal year ending June 30, 1880, was $8,000, and resulted in securing a channel 100 feet wide and 6 feet deep.

The amount expended during the year ending June 30, 1881, is $3,423.03, and has resulted in partially deepening the channel to 7 feet, as proposed.

No further appropriation is required.

July 1, 1880, amount available		$7,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$1,121 35	
July 1, 1881, outstanding liabilities	2,306 68	
		3,428 03
July 1, 1881, amount available		3,571 97

(See Appendix I I 19.)

20. *Ice-harbor of refuge, Belle River, Michigan.*—The act of March 3, 1879, required a "resurvey of bar at mouth of Belle River, Michigan." The report was submitted, and is found printed in annual report, 1880, forming Appendix G G 22, and by the act of March 3, 1881, $7,000 was appropriated for removing the bar.

Belle River is about 140 feet in width and from 7 to 9 feet deep at the lower reaches, which it is intended to improve.

The project for improvement was adopted in 1880, the object being to afford a channel 50 feet wide, 13 feet deep to the first bridge and 12 feet deep to the second.

No money has as yet been expended upon the improvement.

The amount that can be profitably expended during the year ending June 30, 1883, is $5,000, which, if appropriated, will be expended in rectifying dock lines at the mouth of the river.

The estimated cost for the completion of the whole work is $5,000.

Amount appropriated by act approved March 3, 1881	$7,000 00
July 1, 1881, amount available	7,000 00
Amount (estimated) required for completion of existing project	5,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	5,000 00

(See Appendix I I 20.)

21. *Clinton River, Michigan.*—In 1870 the channel of entrance to this river was very shallow, the shoalest place showing only 3½ feet of water, whilst the river was 10 feet in depth.

A project of improving the channel was adopted and approved in 1870, the object being to afford a channel 50 feet wide at bottom with a depth of 8 feet, and in the execution of this improvement the amount expended up to close of fiscal year ending June 30, 1880, was $5,000.

In compliance with the acts of March 3, 1879, and June 14, 1880, a resurvey at mouth of Clinton River was made and report submitted and printed, forming Appendix G G, annual report of 1880, and by the act of March 3, 1881, $8,000 was appropriated for continuing this improvement.

It has been decided to apply this money to dredging a cut 8 feet deep and 60 feet wide at the entrance of the river.

The officer in charge estimates that $25,000 can be profitably expended during the next fiscal year, and that amount, he reports, will complete the improvement.

Amount appropriated by act approved March 3, 1881	$8,000 00
July 1, 1881, amount available	8,000 00
Amount (estimated) required for completion of existing project	25,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	25,000 00

(See Appendix I I 21.)

22. *Saint Clair Flats Ship-Canal, Michigan.*—This canal was projected in 1866, the object being to afford a straight channel 300 feet wide in the clear and 13 feet deep, and modified in 1874 so as to make the canal 200 feet wide with a depth of 16 feet, and the amount expended to June 30, 1880—$588,987.62—has resulted in securing a channel of this width and depth.

The amount expended in repairs during the year ending June 30, 1881, is $2,556.47.

July 1, 1880, amount available	$2,623 94
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,556 47
July 1, 1881, amount available	67 47

(See Appendix I I 22.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with the requirements of the river and harbor act of June 14, 1880, Major Harwood has submitted reports upon the following examinations and surveys which have been submitted to Congress:

1. *Grand River, below Grand Rapids, Michigan.* Printed in Senate

Ex. Doc. 50, Forty-sixth Congress, third session. (See, also, Appendix I I 10.)

2. *Swan Creek, Lake Saint Clair, Michigan.* Printed in House Ex. Doc. 79, Forty-sixth Congress, third session. (See, also, Appendix I I 23.)

3. *Empire Bay, Leelenaw County, Michigan.* Printed in House Ex. Doc. 79, Forty-sixth Congress, third session. (See, also, Appendix I I 24.)

And to comply with the provisions of the river and harbor act of March 3, 1881, he is charged with and is now engaged upon examination and survey *for harbor at Caseville, Saginaw Bay, Lake Huron,* the results of which will be duly submitted when received.

IMPROVEMENT OF SAINT MARY'S RIVER; ENLARGEMENT OF AND OPERATING SAINT MARY'S FALLS CANAL, MICHIGAN—CONSTRUCTION OF HARBOR OF REFUGE ON LAKE HURON—IMPROVEMENT OF DETROIT RIVER.

Officer in charge, Maj. G. Weitzel, Corps of Engineers, with Capt. B. D. Greene, Corps of Engineers, under his immediate orders until February 26, 1881.

1. *Saint Mary's River and Saint Mary's Falls Canal, Michigan.*—A depth of about 11 feet 6 inches could be carried through the channel between Lakes Superior and Huron, when the government began its improvement in 1870. The canal had a depth of 12 feet at the ordinary stage. Its sides were slopes paved with rough stone. Its width at bottom was 62 feet, and at the water surface 100 feet. The originally adopted project was to deepen the canal to admit a draught of vessels at ordinary stages of 16 feet; to widen the canal and substitute nearly vertical timber crib revetment on the sides for the rough stone slopes; to construct a new lock with a single lift of 18 feet and a capacity of 515 by 80 feet for a draught of 17 feet; to build a branch canal from this new lock to the river below and the enlarged canal above; to excavate a large basin for supplying lockage water at the head of the old and new locks, and to construct a guard-gate at the head of the former. The straightening of the south bank of the canal at its head and constructing a new, larger, and improved movable dam, to serve the purpose of guard-gates, near the head, were the two most important additions to the original project.

The original project for the improvement of the river was adopted in 1879, and consisted in deepening the present navigable channel to 16 feet at every place except East Neebish, which it was believed the Canadian Government would improve.

The amount expended on this improvement up to the close of the fiscal year ending June 30, 1880, was $1,797,514.80.

Its availability or adaptability for the purposes of navigation and commerce were no better nor greater than when the work was first begun, excepting that the prism of the canal was wider and deeper and could be more easily entered and navigated.

The sum expended on the work during the year ending June 30, 1881, was $322,154.79.

With the amount appropriated for the fiscal year ending June 30, 1882, it is intended to complete the work according to its original and modified project. This, however, does not include the East Neebish. Another appropriation must be made for this portion of the river, but the amount cannot be stated until after the contemplated survey has been made, and the results reported.

July 1, 1880, amount available	$457,485 20	
Amount appropriated by act approved March 3, 1881	150,000 00	
		$607,485 20
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		322,154 79
July 1, 1881, amount available		285,330 41

(See Appendix J J 1.)

Operating Saint Mary's Falls Canal, Michigan.—In consequence of legislation by Congress in the river and harbor act of June 14, 1880, and the act passed by the legislature of Michigan, approved March 3, 1881, the canal was actually transferred to the government on June 9, 1881. During the past year it was open for navigation only 198 days. It was closed as early as November 15, 1880, for the season, in order to enable a dam to be placed across its head, so that the water might be drawn off for the winter's work; 3,304 vessels, with a registered tonnage of 1,802,571 tons, carrying 1,258,468 tons of freight and 19,971 passengers, passed through. The staple articles which were carried by these vessels were 195,448 tons of coal, 21,189 tons of copper, 525,060 barrels of flour, 3,901,332 bushels of grain, 653,518 tons of iron ore, 53,935 tons of manufactured iron, 41,357,000 feet, b. m., of lumber, and 58,517 barrels of salt.

The expense of operating it during the period from June 9 to June 30, 1881, inclusive, was $1,306.51.

The river and harbor act of March 3, 1881, provides that hereafter, for the purpose of operating and keeping this canal in repair, the Secretary of War is authorized to draw his requisition on the Secretary of the Treasury from time to time.

(See Appendix J J 1.)

2. *Harbor of Refuge, Sand Beach, Lake Huron, Michigan.*—The present project for the construction of this harbor was adopted in 1873. Its object is to furnish a harbor of refuge to the vessels engaged in the commerce of the northern and northwestern lakes when caught by heavy weather near the dangerous Point Aux Barques. Before the year 1876, whenever vessels were so caught they were compelled to run back a distance of 60 miles and take refuge in Saint Clair River.

The amount expended to June 30, 1880, is $614,070.13.

At the close of the fiscal year ending June 30, 1881, 4,880 feet of breakwater had been completed and 650 feet partially completed.

The amount that can be profitably expended during the year ending June 30, 1883, is $100,000, and this amount, if appropriated, will be expended in completing the substructure of the lake arm and the south shore arm of the breakwater, as well as in dredging inside of the harbor.

The amount required for the entire completion of the work according to the modified project is $200,000.

The total number of vessels which were driven to take refuge in this incomplete harbor in the eight months of navigation during last year was 1,018, of which 115 were passenger vessels.

July 1, 1880, amount available	$160,929 87	
Amount appropriated by act approved March 3, 1881	50,000 00	
		$210,929 87
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		97,481 92
July 1, 1881, amount available		113,447 95

Amount (estimated) required for completion of existing project	$200,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	100,000 00

(See Appendix J J 2.)

3. *Detroit River.*—The original condition of the navigable channel at Lime Kiln Crossing was such that vessels drawing 13 feet of water could often barely pass. A ridge of limestone lies entirely across the bed of the river, and over the top of this ridge are scattered boulders of all sizes and in large quantities. The object of this improvement is to make a cut through this ridge along the main channel to a width of 300 feet, in which cut there shall be a depth of 20 feet in ordinary low-water stages. The originally adopted project was to make this cut. No amendments have been made in it except to change the direction of the lower half of it slightly. The amount expended on this work to June 30, 1880, was $99,817.45.

The amount expended during the last fiscal year was $79,967.77. The only benefit resulting from this has been to bring the cut nearer its completion. It is only then that any benefit from the work will result. Incidentally during the past year a better temporary channel has been created. The amount that can be profitably expended during the fiscal year ending June 30, 1883, is $186,000, and should this sum be appropriated, it is expected that the improvement will be completed.

The amount of benefit that will arise from this work is that it will prevent the present loss by detention and allow the great number of 40,000 vessels which pass this point annually to load to a deeper draught, and will thus, in the judgment of the officer in charge, lower the rate of freights sufficiently to pay for the whole work in two good seasons. The total estimated amount required to complete the work is $186,000.

July 1, 1880, amount available	$125,182 55	
Amount appropriated by act approved March 3, 1881	50,000 00	
		$175,182 55
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		79,967 77
July 1, 1881, amount available		95,214 78

Amount (estimated) required for completion of existing project	$186,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	186,000 00

(See Appendix J J 3.)

IMPROVEMENT OF HARBORS ON LAKE ERIE, WEST OF DUNKIRK.

Officer in charge, Maj. John M. Wilson, Corps of Engineers, with Capt. M. B. Adams, Corps of Engineers, under his immediate orders.

1. *Monroe Harbor, Michigan.*—The original project for the improvement of this harbor was adopted in 1835, when Monroe was a town of considerable importance, and when the navigable waters of the river Raisin were separated from the waters of Lake Erie by extensive shoals. This project provided for cutting a canal between the river and the lake, 4,000 feet long and 100 feet wide, through the peninsula called "River Raisin Point," and protecting the entrance into the lake by parallel piers 726 feet long and 20 feet wide, running out to a depth of 10 feet into the lake; the object was to afford a channel of entrance of navigable width and not less than 10 feet in depth.

Work was commenced in 1835, and has been continued from time to time since that date, and at the close of the present fiscal year there was a good channel with a depth of 10 feet up to a point just below the docks at Monroe, which is quite equal to that which was originally projected, and sufficient for the present commerce of the port.

During the present fiscal year, operations have been confined to such repairs of piers as were absolutely necessary. During the present season it is proposed to repair and strengthen 1,500 linear feet, and to rebuild 600 linear feet of the revetment of the United States canal.

The amount expended up to the close of the present fiscal year is $209,837.46, and has resulted in securing a navigable channel with a depth of not less than 10 feet up to the point where the rock crops out just below the docks at Monroe.

The sum of $2,000, which is required to complete the present project, can be profitably expended during the fiscal year ending June 30, 1883, and if appropriated will be applied to finishing the repairs of the piers and of the revetment of the United States canal.

July 1, 1880, amount available	$2,000 00	
Amount appropriated by act approved March 3, 1881	1,000 00	
		$3,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		322 19
July 1, 1881, amount available		2,677 81
Amount (estimated) required for completion of existing project		2,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		2,000 00

(See Appendix K K 1.)

2. *Toledo Harbor, Ohio.*—When operations were commenced for the improvement of this harbor in 1866, the channel through the bay was narrow and intricate, presenting a depth of only 11 feet.

The original project provided for widening the channel to 200 feet with a depth of 12 feet, and this was amended from time to time until the adoption of the present project, which provides for a channel 250 feet wide at the surface and 200 feet at the bottom, with a depth of 16 feet at low-water.

In 1868 there was a channel 100 feet wide and 12 feet deep, and by 1875 this depth had been increased to 14 feet; by 1879 the width had been increased to nearly 200 feet with a depth of from 13 to 15 feet, and at the close of the fiscal year ending June 30, 1880, there was a channel 200 feet wide with a depth of from 14 to 16 feet.

Up to the close of the fiscal year ending June 30, 1880, the sum of $557,842.19 had been expended upon the work. During the fiscal year ending June 30, 1881, the sum of $35,918.17 was expended; the channel was widened to 200 feet and deepened to 16 feet on the various ranges and widened to 350 feet at the angles, as far as the Turtle Island Range, 172,013 cubic yards of mud, sand, &c., having been removed.

At the close of the fiscal year 1881 there was a good channel 200 feet wide between Toledo and the lake, with a depth of from 14.7 to 17 feet, except at a few minor points where occasional lumps had been left in dredging.

The sum of $100,000 can be profitably expended during the fiscal year ending June 30, 1883, and if appropriated will be applied to widening and deepening the channel between Toledo and the depth of 16 feet at low-water in the lake, which will render it navigable at all times for the larger class of vessels.

The sum of $130,000 is required for the completion of the project.

July 1, 1880, amount available	$36,863 31	
Amount appropriated by act approved March 3, 1881	40,000 00	
		$76,863 31
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	35,918 17	
July 1, 1881, outstanding liabilities	68 40	
		35,986 57
July 1, 1881, amount available		40,876 74
Amount (estimated) required for completion of existing project		130,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		100,000 00

(See Appendix K K 2.)

3. *Port Clinton Harbor, Ohio.*—The first survey of this harbor under the general government was made in 1867, but no action was taken upon it. Under the act of July 11, 1870, a new survey was made, which showed a narrow, intricate channel at the mouth of the Portage River, with a depth of about 5 feet; the original project based upon this survey provided for cutting a new channel 8 feet deep through the outer bar and constructing piers from the shore lakeward to the necessary depth. Efforts were made during the years 1872, 1873, and 1874 to obtain a channel 8 feet deep without building the piers, but that depth could not be maintained.

The present project, adopted in 1875, consists of a pile revetment running from the north shore of the Portage River, opposite the town, about 1,000 feet out into the lake, in a direction north 57° east, and then inclining towards the north; a pile pier about 1,200 feet long extends to the depth of 10 feet in the lake; parallel to this and 200 feet from it, an east pier 2,400 feet long will run out from the south shore of the river. It is expected that a full depth of 9 feet can be maintained by confining the waters of the Portage River between these piers.

Up to the close of the fiscal year ending June 30, 1880, the sum of $21,172.45 had been expended; 1,000 linear feet of the pile revetment running from the north shore had been completed, and work was well advanced upon 300 feet of the pile pier; 800 feet of the east pile revetment had been completed, and work was well advanced upon 300 feet more. The depth at the entrance to the harbor was about 4 feet.

The sum of $13,274.67 was expended during the fiscal year ending June 30, 1881; 450 feet of the west pile pier was completed, and the work upon 120 additional feet well advanced; 954 feet of the east pile revetment was completed and the work upon 250 additional feet well advanced; the depth in the channel has increased so that instead of 4 feet at the entrance, as in June, 1880, there was from 7½ to 10 feet on June 30, 1881. Although the original estimate for this work was $122,000, it is thought that the harbor as projected can be finished for $85,000; $40,000 has already been appropriated, and $45,000 will be required to complete the project. The sum of $20,000 can be profitably expended during the fiscal year ending June 30, 1883, in extending the piers out to a depth of 10 feet in the lake.

July 1, 1880, amount available	$13,827 55	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$18,827 55
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	10,757 49	
July 1, 1881, outstanding liabilities	2,517 18	
		13,274 67
July 1, 1881, amount available		5,552 88

Amount (estimated) required for completion of existing project	$45 000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	20,000 00

(See Appendix K K 3.)

4. *Sandusky City Harbor, Ohio.*—The original survey of this harbor by the general government was made in 1826, but no appropriation was made until 1844. In the latter year the depth on the outer bar was 10 feet, and the greatest depth in the bay was about 12 feet. There was an extensive breach in the peninsula which protects the harbor on the north and northwest, and the original project provided for closing this breach by crib-work and deepening the channel through the outer bar to 12 feet.

The appropriations made in 1844 and 1852 were devoted to closing the breach in the peninsula, but the failure of further appropriations left the work unfinished, and in 1864, when operations were renewed, the old work was found to have been destroyed.

In 1864 a project was submitted for opening a channel 400 feet wide and 12 feet deep through the outer bar, and this has been amended from time to time until the present, when the project calls for a channel through the outer bar and through the bay up to within 50 feet of the line of docks and then parallel to the docks, the portion through the bar and bay to be 200 feet wide and that parallel to the docks 100 feet wide, the whole to be 15 feet deep. In 1869 the channel through the outer bar was 240 feet wide and 12 feet deep; in 1872 the depth was increased to 13 feet and work was commenced upon the channel within the bay; in 1875 there was a channel 100 feet wide and about 15 feet deep through the outer bar and one about 150 feet wide and from 13 to 15 feet deep within the bay up to a point 1⅓ miles from the line of docks at Sandusky City; in 1879 there was a channel through the outer bar 100 feet wide and about 15 feet deep, and through the bay to within about 400 feet of the line of docks with a width of 100 to 200 feet and depth of 15 feet.

With the exception of some slight filling on the outer bar, the condition of the channel on June 30, 1880, was about the same as in 1879.

Up to the close of the fiscal year ending June 30, 1880, the sum of $212,580 had been expended upon this harbor; during the fiscal year ending June 30, 1881, the sum of $11,528.84 was expended; 48,656 cubic yards of mud, sand, &c., have been removed; the channel through the outer bar has been deepened and widened, and that through the bay deepened, widened, straightened, and extended up to a point about 100 feet from the line of docks.

During the present season it is proposed to continue work deepening and widening the channel between deep water in the lake and the docks at Sandusky City.

The sum of $40,000 is required for the completion of the present project, of which amount $20,000 can be profitably expended during the fiscal year ending June 30, 1883, and if available will be applied to deepening and widening the channel leading up to and that parallel with the line of docks.

July 1, 1880, amount available	$12,500 00	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$22,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		11,528 84
July 1, 1881, amount available		10,971 16

Amount (estimated) required for completion of existing project	$40,000 0
Amount that can be profitably expended in fiscal year ending June 30, 1883.	20,000 00

(See Appendix K K 4.)

5. *Sandusky River, Ohio.*—During the years 1867 and 1872, the sum of $30,000 was expended in opening a navigable channel, with a depth of 8 feet, from Sandusky Bay to Fremont, a distance of 17 miles; since 1872 the cuts made through the various bars at that time have filled up.

In August, 1880, a survey was made which showed a least depth of 6 feet on the outer bar, and that the channel through the various bars in the river was very narrow and presented in many places a depth of only from 5 to 7 feet. A project was submitted for opening a channel 100 feet wide and 9 feet deep between the town of Fremont and the 9-foot curve in the bay, at an estimated cost of $44,000.

During the fiscal year the sum of $9,992.36 has been expended; a survey of the river has been made, and 44,976¼ cubic yards of mud, sand, silt, &c., have been removed; a channel about 70 feet wide and 9½ feet deep has been opened through the various bars in the river proper, and one 50 feet wide, 9½ feet deep, and about 1 mile long, has been dredged through the outer bar to the depth of 8¼ feet in Sandusky Bay.

During the present season it is proposed to continue operations deepening and widening the channel through the outer bar.

The estimated amount required for the completion of the present project is $26,500; of this sum, $10,000 can be profitably expended during the fiscal year ending June 30, 1883, and if appropriated will be applied to continuing the work of deepening and widening the channel through the outer bar.

July 1, 1880, amount avilable	$10,000 00	
Amount appropriated by act approved March 3, 1881	7,500 00	
		$17,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		9,992 36
July 1, 1881, amount available		7,507 64
Amount (estimated) required for completion of existing project		26,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		10,000 00

(See Appendix K K 5.)

6. *Huron Harbor, Ohio.*—The present project for the improvement of this harbor consists of parallel piers, 140 feet apart, running out into the lake; it was adopted in 1826 and modified in 1871, the object being to afford a channel of entrance of navigable width and of not less than 14 feet in depth. When work was commenced, in 1827, there was a bar at the mouth of the river, dry at low-water. In 1828 a depth of at least 6 feet was obtained in the channel; by the close of 1829 vessels drawing 7 feet were able to enter the harbor, and in 1839 the channel was 130 feet wide at its narrowest part with a depth of not less than 9½ feet. In 1844 this depth was found to have been maintained, but in 1852, as very little work had been done for fourteen years, the piers were found to be dilapidated and the channel to have shoaled.

In 1866 a depth of 11 feet was reported at the entrance, and by 1872 this depth had been increased to 14 feet.

At the close of the fiscal year there was a good wide channel through the outer bar with a least depth of 14¼ feet at low-water, and between the piers with a depth of from 14½ to 17 feet.

During the fiscal year a breakwater was built at the inner end of the west pier, to prevent the lake from breaking through into the river, and the piers were repaired where necessary.

The amount expended to June 30, 1881, was $100,178.80, and has resulted in securing a good wide channel with a least depth of 14¼ feet, where originally there was a sand-bar dry at low-water.

The appropriation of $8,000 asked for is to be applied to renewing the superstructure upon part of the west pier.

The estimated cost of renewing the entire superstructure of the piers is $22,000.

July 1, 1880, amount available	$3,000 00	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$6,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		1,905 09
July 1, 1881, amount available		4,994 91
Amount (estimated) required for completion of existing project		22,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		8,000 00

(See Appendix K K 6.)

7. *Vermillion Harbor, Ohio.*—Operations were commenced at this harbor in 1826, when the mouth of the Vermillion River was closed by a sand-bar, upon which there was a depth of less than 2 feet water.

The original project consisted of parallel piers running out to the depth of 12 feet water in the lake from each side of the mouth of the river, in order to secure a depth of 10 feet water; this project has been amended from time to time by prolonging the piers, and at present the depth proposed is 14 feet.

In 1838 there was a channel 50 feet wide and 6 feet deep at the entrance. No appropriations were made between the years 1838 and 1866, but in 1854 there was a depth of 8 feet in the channel. In 1865 the piers were dilapidated and the depth at the entrance only 7 feet; in 1872 there was a channel 50 feet wide and 11 feet deep, and in 1878 this was increased to 70 feet in width and about 12 feet in depth; at the close of the fiscal year ending June 30, 1880, the channel had shoaled somewhat, but there was a least depth of about 11 feet between the lake and the inner end of the piers.

The amount expended up to June 30, 1880, was $107,942.32.

The sum of $3,082.08 was expended during the fiscal year ending June 30, 1881.

During the fiscal year a cut has been dredged from the lake up into the river, 26 feet wide and 14 feet deep, except at two points where solid rock was encountered at 13 feet.

The repairs of the east pier, which was seriously damaged by the freshet in February, 1881, were commenced in June and well advanced at the close of the year.

The heavy gales in the fall of 1880 filled up the cut through the outer bar so that at present there is a depth of only from 11½ to 13 feet on that bar and from 13 to 17 feet in the middle of the channel between the piers.

The amount estimated for the completion of the present project is $15,000; the whole of this sum can be profitably expended in blasting and dredging rock, shale, and sand during the fiscal year ending June 30, 1883.

July 1, 1880, amount available	$2,000 00	
Amount appropriated by act approved March 3, 1881	2,000 00	
		$4,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		3,082 08
July 1, 1881, amount available		917 92

Amount (estimated) required for completion of existing project	$15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	15,000 00

(See Appendix K K 7.)

8. *Mouth of Black River, Ohio.*—The present project for the improvement of this harbor consists of parallel piers 200 feet apart running out to a depth of 16 feet in the lake; it was adopted in 1828, modified so as to gain increased depth in 1873, and again in 1880, the object being to afford a channel of entrance of navigable width and not less than 16 feet in depth. When work was commenced in 1828 there was a depth of only 3 feet at the entrance; by 1833 there was a channel with a least depth of 7½ feet and in 1839 there was a depth of 9½ feet, which increased to 14 feet as the lake was approached.

But one small appropiation of $5,000 was made between the years 1838 and 1865, and in the latter year the piers were found to be in a dilapidated condition, but a narrow channel still remained near the west pier with a depth of from 7 to 10 feet; its width and depth were gradually increased and in 1871 there was a depth of 12 feet, in 1874 of 14 feet, and at the close of the fiscal year there was a good wide channel with a depth of 15 feet from the lake up into the river. During the fiscal year operations have been confined to such minor repairs of the piers as from time to time became necessary.

The amount expended to June 30, 1881, is $175,208.99, and has resulted in securing a good wide channel with a depth of not less than 15 feet.

The appropriation of $20,000 asked for is to be applied to prolonging the piers in order to gain a depth of 16 feet at the entrance to the harbor.

July 1, 1880, amount available	$1,000 00	
Amount appropriated by act approved March 3, 1881	7,000 00	
		$8,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		70 26
July 1, 1881, amount available		7,929 74
Amount (estimated) required for completion of existing project		35,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		20,000 00

(See Appendix K K 8.)

9. *Rocky River, Ohio.*—The project for this harbor was adopted in 1871, the object being to afford a channel of entrance 100 feet wide and from 6 to 12 feet deep; it required the construction of a pier 500 feet long and a large amount of excavation.

The pier as projected was constructed, but only a small amount of excavation was done, and no further appropriations for continuing the work were made after March 3, 1875.

By the act of June 14, 1880, an appropriation of $4,000 was made for repairs, and during the past fiscal year the pier has been thoroughly repaired and is now in excellent condition.

No further appropriation is asked for.

July 1, 1880, amount available	$4,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,407 99
July 1, 1881, amount available	1,592 01

(See Appendix K K 9.)

10. *Cleveland Harbor, Ohio.*—The present project for the improvement of the mouth of the Cuyahoga River was adopted in 1825, and has been

amended from time to time in order to gain increased depth; it consists of parallel piers about 200 feet apart, running out to a depth of 16 feet in the lake. When operations were commenced in 1825, there was a long, low, sand-bar where the river now empties into Lake Erie, and the entrance was through a narrow, intricate channel, with a depth of about 3 feet; in 1828 there was a channel through the sand-bar with a depth of 6 feet; in 1833 there was a depth of 11 feet, and in 1839, when work was suspended, there was a good channel with a depth sufficient for the largest vessels navigating the lakes to enter at all times.

This depth was found to be maintained in 1844 and 1852. In 1864 the piers were in a dilapidated condition, but the channel still presented a depth sufficient to admit vessels drawing 11 feet; in 1871 the depth was increased to 16 feet; at the close of the fiscal year ending June 30, 1880, there was a good wide channel between the piers with a depth of from 16 to 18 feet, and through the outer bar with a depth of from 17 to 19 feet; at the close of the fiscal year ending June 30, 1881, there was still an excellent channel; some slight shoaling had occurred, but there was still a depth of from 16 to 20 feet. The total amount expended up to the close of the fiscal year ending June 30, 1880, at the mouth of the river was $350,000. No work, other than some minor repairs to piers, has been done during the fiscal year. During the present season it is proposed to construct a pile protection upon the line of the channel face of the west pier, across the wider part of the channel, to prevent vessels from running on the débris of the old work built previous to 1850; also to make such repairs to the piers as may be necessary.

The new breakwater.—The present project for a harbor of refuge provides for an outer breakwater starting from the lake shore about 700 feet west of the upper end of the old river bed.

This breakwater runs out in a direction about due north a distance of 3,130 feet to a depth of 28 feet water; the angle is then turned and it runs for about 4,000 feet nearly parallel to the shore in a depth of from 28 to 30 feet water. The entrance to the harbor on the east side will be protected by prolonging one of the piers at the mouth of the river from 1,000 to 1,500 feet.

At the close of the fiscal year ending June 30, 1880, the sum of $200,858.44 had been expended on the work; 2,550 linear feet of the arm running from the shore had been entirely completed, and 300 feet of crib-work in addition had been sunk.

During the fiscal year ending June 30, 1881, the sum of $69,195.36 was expended, and at the close of the year 3,300 feet of the breakwater was completed and 300 feet of crib-work in addition was sunk.

During the fiscal year ending June 30, 1883, the sum of $300,000 can be profitably expended, and, if available, will be applied to completing the lake arm of the breakwater.

During the present season work will be continued, extending the breakwater.

The original estimate for this work was $1,800,000. The engineer in charge reports that, unless some unforeseen contingency arises, he hopes to build it for $1,200,000, or two-thirds of the original estimate.

Up to the close of the fiscal year $625,000 has been appropriated, leaving to be appropriated, under the revised estimate, for completing the work the sum of $575,000.

When finished, the harbor will present an outer dock-line in 12 feet water 1 mile long, and an area for anchorage of 180 acres, the depth in 140 acres of which will vary from 17 to 29 feet.

Although the balance available June 30, 1881, is reported as $348,592.72, contracts have been made for work to cover the whole sum, and it will probably all be expended by October, 1882.

July, 1, 1880, amount available	$224,143 89	
Amount appropriated by act approved March 3, 1881	200,000 00	
		$424,143 89
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	69,195 36	
July 1, 1881, outstanding liabilities	6,355 81	
		75,551 17
July 1, 1881, amount available		348,592 72
Amount (estimated) required for completion of existing project		575,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		300,000 00

(See Appendix K K 10.)

11. *Fairport Harbor, Ohio.*—The present project for the improvement of this harbor consists of parallel piers, 200 feet apart, running out into the lake; it was adopted in 1825, and modified by prolonging the piers so as to gain increased depth from time to time since that date, the object being to afford a channel of entrance of navigable width and not less than 15 feet in depth.

When the work of improvement was commenced, in 1826, the mouth of the river was closed by a sand-bar 1,200 feet wide, at times so dry and hard that teams could be driven across.

In 1829 the depth in the channel was from 7½ to 8½ feet, and in 1839, when work was suspended, there was a depth of 11 feet, and any vessel then navigating the lakes could enter at any time without danger. In 1844 the piers were dilapidated, but there was still a depth of 11 feet in the channel. In 1853 the depth was about 12 feet, but a bar was slowly extending around the outer end of the west pier.

In 1865 the piers were found to be seriously dilapidated; in 1870 there was a depth of 12 feet in the channel; in 1879 this depth was increased to 14 feet, and at the close of the fiscal year there is a good wide channel with a depth of not less than 15 feet.

Operations during the fiscal year have been confined to minor repairs of the piers.

The amount expended to June 30, 1881, is $204,345.82, and has resulted in securing a good wide channel with a least depth of 15 feet.

The appropriation of $30,000 asked for is to be applied to prolonging the piers, in order to maintain a full depth of 15 feet.

The sum of $67,300 is required to complete the present project.

July 1, 1880, amount available	$3,515 66	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$13,515 66
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		190 99
July 1, 1881, amount available		13,324 67
Amount (estimated) required for completion of existing project		67,300 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		30,000 00

(See Appendix K K 11.)

12. *Ashtabula Harbor, Ohio.*—The original project for this harbor, adopted in 1826, when the rock bottom was found 9 feet below the surface and there was a depth of only 2 feet water on the bar at the entrance, provided for piers starting from the shore on either side of the mouth of the river, and running out to a depth of 12 feet in the lake; these piers at their beginning were 160 feet apart, but the west one inclined to the

eastward for the first 900 feet, so as to narrow the channel to 100 feet, and then flared to the westward, again widening it to 160 feet.

The present project provides for extending the piers out to a depth of 16 feet; removing the decayed inner portion of the west pier; revetting the river bank, and deepening the channel to 16 feet.

Work was commenced in 1826, and by the year 1839, when operations were suspended, there was a good channel into the harbor with a depth of 9 feet. No work, other than some necessary repairs of piers, was done between the years 1838 and 1866, a period of 28 years. In 1866 the piers were found to be in a very dilapidated condition, and the channel to have shoaled somewhat; by 1870 there was a channel 70 feet wide and about 12 feet deep, rock having been removed from 1 to 4 feet deep; in 1876 the channel was widened to 100 feet and deepened to about 14 feet. Up to the close of the fiscal year ending June 30, 1880, the sum of $281,657.07 had been expended, and there was a channel 100 feet wide and from 14½ to 17 feet deep between the lake and the river above the inner end of the piers.

During the fiscal year the sum of $13,319.49 was expended; the east pier has been extended 200 feet, and 200 linear feet of crib-work has been sunk upon the prolongation of the west pier; the outer bar has shoaled during the year, but every effort has been made by dredging to maintain a good channel through it, and at the close of the fiscal year there was a depth of from 15 to 17 feet between the lake and the river, but the channel was slightly narrower through the outer bar.

During the present season it is proposed to extend the east pier 120 feet; to complete the extension of the west pier 400 feet, and to open the channel through the outer bar to a width of 120 feet and depth of from 15 to 17 feet.

The sum of $48,000 is required to complete the present project; of this amount $40,000 can be profitably expended during the fiscal year ending June 30, 1883, in completing the piers, constructing revetment, and dredging.

The engineer in charge refers to the constant trouble experienced at this harbor from the sand drifting around the outer end of the west pier.

July 1, 1880, amount available	$28,247 54	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$48,247 54
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	13,319 49	
July 1, 1881, outstanding liabilities	1,047 44	
		14,366 93
July 1, 1881, amount available		33,880 61
Amount (estimated) required for completion of existing project		48,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		40,000 00

(See Appendix K K 12.)

13. *Conneaut Harbor, Ohio.*—When operations were originally commenced for the improvement of this harbor in 1829 the mouth of the stream was closed by a bar which was dry at low-water.

The original project adopted in 1829, and modified in 1866, consists of parallel piers, 125 feet apart, running out to a depth of 12 feet water in the lake and flaring at their outer ends; the object was to afford a channel of entrance of navigable width and of not less than 12 feet in depth.

By the autumn of 1831 there was a depth of 8 feet in the channel, and by the close of the year 1839 the depth was increased to 11 feet; no work was done between the years 1838 and 1844, and in the latter year the piers were found to be dilapidated and the channel to have shoaled to 8 feet. In 1855 the depth was from 9 to 10 feet and in 1866 from 8½ to 12 feet. In 1879 the piers were in a dilapidated condition, but there was a depth of from 10½ to 16 feet between them; at the close of the fiscal year (June 30, 1881) there was a depth of from 12 to 17 feet between the piers, but there was a serious bar just outside upon which there was a least depth of 6 feet; there was a breach 450 feet wide in the east pier.

No work has been done during the fiscal year other than to make the necessary examinations and enter into contract for the construction of a pile work to cover the breach; this will be built during the present season.

Up to the close of the fiscal year the sum of $106,723.13 has been expended upon this harbor.

The estimated cost of putting the piers in good order is $30,000, the whole of which can be profitably expended during the fiscal year ending June 30, 1883, and if appropriated will be applied to that purpose.

July 1, 1880, amount available	$6,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	93 74
July 1, 1881, amount available	5,906 26
Amount (estimated) required for completion of existing project	30,000 00
Amount that can be profitably expended in the fiscal year ending June 30, 1883	30,000 00

(See Appendix K K 13.)

14. *Erie Harbor, Pennsylvania.*—The original survey of this harbor, under the Chief of Engineers, was made in 1819, when there was a long, low sand-bar stretching across the present entrance, the channel being narrow and tortuous, with a depth of only 6 feet. By the act of March 3, 1823, a new survey was made, and a Board of Engineers, consisting of General Simon Bernard and Lieut. Col. J. G. Totten, submitted the following plan of improvement:

> To form parallel embankments, separated 200 feet, from near Block House Point to deep water in the lake, and, with the exception of this passage, to close the whole of the mouth of the basin by a line of contiguous piles from Block House Point to Hospital Point, terminating the embankments in the lake by two strong piers, each standing obliquely to the embankment with which it is connected, and in the basin by placing the parts within the lines of piles also obliquely.

The plan of the Board was approved and carried out, and has been amended from time to time by extending the piers further out into the lake. At present the project provides for the prolongation of the piers out to 16 feet water in the lake, and the maintenance of that depth at the entrance to the harbor.

When the work of improvement was commenced in 1824 the channel at the entrance was narrow and tortuous, with a depth of only 6 feet, and the depth on the present line of channel was only 2 feet. By 1827 vessels of ordinary draught were enabled to enter the harbor; by 1829 the depth of the entrance was from 7½ to 15 feet, and in 1833 there was a good channel with a depth of 12 feet from the lake into the bay, and this depth was maintained to 1839, when operations were suspended. In 1844 the piers were in a dilapidated condition; there was a depth of 18 feet between them, but shoals were forming at each end; in 1864 there was still a depth of 12 feet at the entrance, but the channel was narrow and crooked, and had been driven to the southward by the sand drifting around the north pier; in 1868 the channel was straightened and the depth increased to 13 feet with a width of 100 feet. The width and depth have been increased from time to time since 1868, more or less shoaling taking place in the meanwhile, and at the close of the fiscal year ending June 30, 1880, there was a channel 300 feet wide, and not less than 16 feet deep, from the lake to deep water in the bay.

Up to the close of the fiscal year 1879–'80 the sum of $560,508.67 had been expended on this harbor, but of this amount about one-third was expended in protecting the peninsula, and upon a plan for a western entrance; this latter was abandoned when work was resumed in 1864.

During the present fiscal year $24,496.99 was expended; the crib-work of the north pier was extended 160 feet, and of the south pier 150 feet. Both piers have been thoroughly repaired. The full depth of 16 feet and width of 300 feet has been maintained at the entrance. Considerable work has been done for the protection of the peninsula of Presqu'ile, as upon it depends the security of the harbor; 9 pile jetties have been built and the protection fences repaired from time to time.

During the present season it is proposed to complete the extension of the north pier 240 feet, and of the south pier 420 feet; to deepen the channel to 16 feet at lowest low-water, and to protect the lake shore of the peninsula where necessary.

The amount necessary to complete the present project is $91,000; of this sum $40,000 can be profitably expended during the fiscal year ending June 30, 1883, and if available will be applied to extending the piers and protecting the peninsula, in order to maintain the harbor and the depth of 16 feet at low-water at its entrance.

June 1, 1880, amount available	$55,858 56	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$75,858 56
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	23,196 02	
July 1, 1881, outstanding liabilities	1,300 97	
		24,496 99
July 1, 1881, amount available		51,361 57
Amount (estimated) required for completion of existing project		91,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		40,000 00

(See Appendix K K 14.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with the requirements of the river and harbor act of June 14, 1880, Major Wilson was charged with and has completed the following, the results of which were duly transmitted to Congress and printed in Senate Ex. Doc. No. 41, Forty-sixth Congress, third session:

1. *Sandusky River, near Fremont, Ohio.* (See also Appendix K K 5.)
2. *Chagrin River, Ohio.* (See also Appendix K K 15.)
3. *Toledo Harbor, Ohio, for a depth of* 16 *feet.* (See also Appendix K K 2.)
4. *Maumee River, Ohio, from Perrysburg to the city of Toledo.* (See also Appendix K K 16.)
5. *Saint Mary's River, from the town of Saint Mary's to its mouth, Ohio.* (See also Appendix K K 17.)

And also the following, printed as Senate Ex. Doc. No. 55, Forty-sixth Congress, third session:

6. *Survey to ascertain the practicability and cost of construction of a ship canal from Lake Erie by the Maumee and Wabash Valleys to the navigable waters of the Wabash River, and a survey and estimate of cost for a similar canal from Junction City, on the Wabash and Erie Canal, by way of the Miami and Erie Canal, to the navigable waters of the Ohio, &c.* (See also Appendix K K 18.)

And to comply with provisions of the river and harbor act of March 3, 1881, he is charged with and is now engaged upon the following, the results of which will be duly submitted when received:

1. *Toledo, Ohio, for a straight channel to Lake Erie.*

IMPROVEMENT OF THE HARBORS OF DUNKIRK AND BUFFALO, LAKE ERIE, AND OF HARBORS ON LAKE ONTARIO AND ON THE RIVERS OF NIAGARA AND SAINT LAWRENCE.

Officer in charge, Maj. Walter McFaland, Corps of Engineers.

1. *Dunkirk Harbor, New York.*—Under the appropriation of June 14, 1880, a contract has been entered into for the extension of the breakwater 150 feet, and the work is to be completed by the close of the working season of 1881.

The present project for the improvement of this harbor was adopted in 1870, the object being to form an artificial harbor by the construction of a breakwater in front of the town, 2,860 feet long, and nearly parallel with the shore, and by excavating the channel to a depth of 13 feet, at an estimated cost of $350,000 (erroneously stated in the last annual report as $262,000).

The channel has been deepened and 1,191 feet of the breakwater have been built at a cost of $88,000, and an additional length of 150 feet will be built under the last appropriation. It is not thought necessary at present to extend this breakwater more than 360 feet further, for which an appropriation of $21,000 is recommended.

July 1, 1880, amount available	$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,891 88
July 1, 1881, amount available	8,108 12
Amount (estimated) required for completion of existing project	252,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	21,000 00

(See Appendix L L 1.)

2. *Buffalo Harbor, New York.*—During the year the breakwater has been extended 694 feet, its total length at the close of the fiscal year being 4,120 feet.

Under the last two appropriations, of 1880 and 1881, two contracts for its further extension have been entered into, one of which is to be completed during the present working season of 1881, and the other during the working season of 1882.

Complaint having been made that the harbor was frequently obstructed by lumber rafts fastened to the breakwater and allowed to swing with the winds, the authorities of the city of Buffalo, in order to prevent further annoyance of this kind, were authorized by the honorable Secretary of War to extend their harbor ordinances to the United States breakwater, and to the harbor formed by it.

July 1, 1880, amount available	$189,970 48	
Amount appropriated by act approved March 3, 1881	90,000 00	
		$279,970 48
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	77,545 87	
July 1, 1881, outstanding liabilities	29,364 32	
		106,910 19
July 1, 1881, amount available		173,060 29
Amount (estimated) required for completion of existing project		1,455,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		300,000 00

(See Appendix L L 2.)

3. *Niagara River at Tonawanda Harbor, New York.*—The appropriation of March 3, 1881, for the improvement of the Niagara River was authorized to be applied to the improvement of Tonawanda Harbor, and contract for dredging it was accordingly entered into, in accordance with the report upon the survey of it, made January 17,1881.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	92 37
July 1, 1881, amount available	4,907 63
Amount (estimated) required for completion of existing project	1,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	1,500 00

(See Appendix L L 3.)

4. *Wilson Harbor, New York.*—Two contracts have been entered into for the extension of the piers, and the work is to be completed during the present working season.

The project for the improvement of this harbor, adopted by appropriation in 1875, provides for the extension of the piers to the 12-foot curve and the excavation of the channel between them to a depth of 12 feet. The piers now extend only to the 8-foot curve, and the channel has been deepened to 8 feet, but during the past season sand has washed into the channel in such a way as to shoal it in some places to 3 feet. The contracts now in force provide for the extension of the west pier 300 feet, and of the east pier 210 feet, and the channel will be again deepened when the west pier extension is completed.

July 1, 1880, amount available	$10,898 41	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$20,898 41
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,073 48
July 1, 1881, amount available		18,824 93
Amount (estimated) required for completion of existing project		60,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		30,000 00

(See Appendix L L 4.)

5. *Olcott Harbor, New York.*—The work of repair by hired labor under the appropriation of March 3, 1881, was commenced.

The scheme for the improvement of this harbor provided for the extension of the piers to the 11-foot curve and the deepening of the channel between them—the estimated cost of which was $118,000. The piers have been carried out only to the 9-foot curve, and the channel between them excavated to the depth of 10 feet through rock which made the work more expensive than had been anticipated. To extend the work to the 11-foot curve and to make the necessary repairs to the decayed superstructure of the piers will require not less than $30,000.

Amount appropriated by act approved March 3, 1881	$3,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	550 67
July 1, 1881, amount available	2,449 33
Amount (estimated) required for completion of existing project	30,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	30,000 00

(See Appendix L L 5.)

6. *Oak Orchard Harbor, New York.*—Arrangements have been made for extensive repairs of the decayed piers, by the use of hired labor. The original scheme for the improvement of this harbor provided for extending the piers to the 12-foot curve, and for deepening the channel between them to 12 feet, which would make it valuable as a harbor of refuge.

The estimated cost of this is $100,000.

July 1, 1880, amount available	$3,775 87
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	217 03
July 1, 1881, amount available	3,558 84
Amount (estimated) required for completion of existing project	100,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	40,000 00

(See Appendix L L 6.)

7. *Charlotte Harbor, New York.*—The year's work has been restricted to the repairs of the piers and the rebuilding of parts of the decayed superstructure.

The original scheme for the improvement of this harbor provided for the construction of two parallel piers extending to the 12-foot curve in the lake, and the deepening of the channel to 12 feet.

This has been accomplished; but the harbor being at the mouth of the Genesee River and forming the port of Rochester, the fifth city in population in the State of New York, is an important one, of very much more than local value, and ought, in the opinion of the officer in charge, to be prepared for the admission of the largest vessels that will be able to pass the Welland Canal when completed, namely, those drawing 14 feet water; and the channel should therefore be deepened to 15 feet, and the piers extended to the 15-foot curve in the lake, the estimated cost of which is $154,000.

July 1, 1880, amount available	$5,574 03	
Amount appropriated by act approved March 3, 1881	2,500 00	
		$8,074 03
July 1, 1881, amount expended during fiscal year, exclusive of oustanding liabilities July 1, 1880	5,361 31	
July 1, 1881, outstanding liabilities	579 57	
		5,940 88
July 1, 1881, amount available		2,133 15
Amount (estimated) required for completion of existing project		154,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		80,000 00

(See Appendix L L 7.)

8. *Pultneyville Harbor, New York.*—Contracts for the extension of both

piers have been formed, and the dredging of the harbor to a depth of 8 feet has been completed.

It would be advisable to extend the west pier still farther into the lake in order to prevent the sand which is accumulating west of it from sweeping around its outer extremity and injuring the channel, and the amount asked for is designed for this purpose.

July 1, 1880, amount available	$4,959 79	
Amount appropriated by act approved March 3, 1881	2,000 00	
		$6,959 79
July 1, 1881, amount expended during fiscal, year exclusive of outstanding liabilities July 1, 1880	1,199 26	
July 1, 1881, outstanding liabilities	526 20	
		1,725 46
July 1, 1881, amount available		5,234 33
Amount (estimated) required for completion of existing project		4,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		4,000 00

(See Appendix L L 8.)

9. *Great Sodus Harbor, New York.*—A contract has been entered into during the year for the deepening one-third of the width of the channel between the piers to 12½ feet.

The original scheme for the improvement of this harbor provided for extending the piers which formed the channel of entrance out to the 12-foot curve in the lake, and the deepening of the channel to 12 feet.

This harbor is, however, becoming one of importance as a coal-shipping port, and it is, in the judgment of the officer in charge, one of the few on Lake Ontario that should be improved to the extent of permitting the entrance of vessels drawing 14 feet water, which is the greatest draft that can be carried through the Welland Canal when completed.

This would require the extension of the piers to the 15-foot curve, and the deepening of the channel to 15 feet, and the cost of this has been estimated for accordingly.

July 1, 1880, amount available	$5,437 80	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$10,437 80
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	271 47	
July 1, 1881, outstanding liabilities	2,989 66	
		3,261 13
July 1, 1881, amount available		7,176 67
Amount (estimated) required for completion of existing project		100,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		40,000 00

(See Appendix L L 9.)

10. *Little Sodus Harbor, New York.*—Contracts have been entered into during the year for the extension of both piers and for the deepening of the channel between them to 15 feet.

The original scheme for the improvement of this harbor provided for extending the piers to the 12-foot curve and the deepening of the channel to 12 feet.

The harbor has, however, become an important one for the shipment of coal, and it is one of the few on Lake Ontario that should, in the opinion of the officer in charge, be prepared for the admission of the largest vessels that will be able to pass through the Welland Canal when completed; that is, vessels drawing 14 feet water. To admit of this the piers should be extended to the 15-foot curve and the channel should be excavated to the same depth, and this has been estimated for accordingly.

July 1, 1880, amount available	$26,923 89	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$46,923 89
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	6,687 95	
July 1, 1881, outstanding liabilities	3,410 63	
		10,098 58
July 1, 1881, amount available		36,825 31
Amount (estimated) required for completion of existing project		80,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		40,000 00

(See Appendix L L 10.)

11. *Oswego Harbor, New York.*—During the year the west breakwater has been extended 463 feet, making its total length, measured along its axis, 5,584 feet.

Contracts have been entered into for completing the west breakwater, beginning the east breakwater, and dredging the channel to a depth of 15 feet between the light-house and the upper end of the upper island. All this work (except the east breakwater) is to be finished during the present working season of 1881.

July 1, 1880, amount available	$120,689 73	
Amount appropriated by act approved March 3, 1881	50,000 00	
		$170,689 73
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	64,463 43	
July 1, 1881, outstanding liabilities	687 35	
		65,150 78
July 1, 1881, amount available		105,538 95
Amount (estimated) required for completion of existing project		237,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		100,000 00

(See Appendix L L 11.)

12. *Ogdensburg Harbor, New York.*—The harbor remains in the same condition as at the close of the preceding fiscal year. Nothing has been expended upon it, nothing appropriated, and nothing is asked for, for the present. The channel should, in the opinion of the officer in charge, be prepared for the admission of the largest vessels which will be able to pass the Welland Canal when completed; but to enable an estimate of this to be made, a preliminary survey will be needed.

Amount (estimated) required for survey to determine cost of deepening channel to 15 feet	$500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	500 00

(See Appendix L L 12.)

13. *Waddington Harbor, New York.*—Work is being done here by hired labor, the last contractor having abandoned his contract, and no bids having been received under the last two calls for them. The work is so difficult and expensive that it does not seem advisable to continue it, considering the little good that is to be accomplished by its execution.

An estimate is, however, submitted of $25,000, which could be expended in continuing operations if Congress should see fit to provide for the same.

July 1, 1880, amount available	$5,807 00	
Amount appropriated by act approved March 3, 1881	2,500 00	
		$8,307 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,781 21	
July 1, 1881, outstanding liabilities	1,736 79	
		4,518 00
July 1, 1881, amount available		3,789 00
Amount (estimated) required for completion of existing project		25,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		25,000 00

(See Appendix L L 13.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with the provisions of the river and harbor act of June 14, 1880, Major McFarland was charged with and has completed the following, the results of which were transmitted to Congress and printed in House Ex. Doc. No. 58, Forty-sixth Congress, third session:

1. *Niagara River, at the mouth of the Tonawanda Creek, New York.* (See Appendix L L 3.)
2. *At Port Day, above the Falls of Niagara, New York.* (See Appendix L L 14.)
3. *Grass River, at Massena, Saint Lawrence County, New York.* (See Appendix L L 15.)

And, also, *Ogdensburg Harbor, New York.*—Provision was made for a survey of this harbor in the act of March 3, 1879, and a report upon the results of the same having been submitted in the last annual report of this office (Appendix J J 11), no further examination was necessary.

Major McFarland is also charged, to comply with requirements of the river and harbor act of March 3, 1881, with—

1. *Survey of Sackett's Harbor, New York*, the results of which will be duly submitted when received.

PACIFIC COAST.

IMPROVEMENT OF THE HARBORS OF OAKLAND AND WILMINGTON; OF SACRAMENTO AND SAN JOAQUIN RIVERS; OF PETALUMA CREEK, AND OF HUMBOLDT BAY AND HARBOR, CALIFORNIA.

Officer in charge, Lieut. Col. G. H. Mendell, Corps of Engineers.

1. *Oakland Harbor, California.*—The present project for the improvement of this harbor was adopted in 1873, and has since been modified in minor respects, particularly as to dredging between jetties to meet the immediate needs of an increasing commerce; its object is to secure a channel of 20 feet at low-water. The natural channel over the bar had little depth, but at the beginning of this improvement had been dredged by the city of Oakland to 5 feet. The amount expended to the close of the fiscal year is $54,642.12, which has resulted in a channel 200 feet wide and 10 feet deep at low-water. The tide adds 5 to 8 feet. It is proposed to expend the appropriation, $200,000, herein asked, in excavation of the basin, as a preliminary measure to secure and maintain a greater depth in the channel.

The operations of the past year were directed to dredging a wider and deeper channel between the jetties and to raising the jetties. These operations are not sufficiently advanced to develope their full benefit.

The freight business of the Central Pacific, the Southern Pacific, and the South Pacific Coast railroads, now passes through this channel.

The great increase in commerce, as found by the statistics, is directly due to this improved condition of the harbor.

The amount expended to the close of the fiscal year ending June 30, 1881, is $316,241.97.

The contracts now in operation will consume about $130,000, leaving the sum of $85,000 or $90,000 available for other operations.

July 1, 1880, amount available	$213,400 15	
Amount appropriated by act approved March 3, 1881	60,000 00	
		$273,400 15
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	49,866 87	
July 1, 1881, outstanding liabilities	4,775 25	
		54,642 12
July 1, 1881, amount available		218,758 03
Amount (estimated) required for completion of existing project		1,244,579 50
Amount that can be profitably expended in fiscal year ending June 30, 1883		300,000 00

(See Appendix M M 1.)

2. *Wilmington Harbor, California.*—The original condition of this harbor was an undefined channel at the entrance, having a depth of 1 foot and at times of 2 feet at mean low-water. There is now a well-defined channel 235 feet in width, having a depth of not less than 10 feet at low-water. At high-water the depth varies from 14 to 18 feet. The coasting vessels habitually enter the harbor. This improvement has been made by the construction of two jetties, to confine and control the tidal currents, and by excavation of the reef which lies at the entrance.

Last year's appropriation was applied to widen the cut through the reef from 150 to 235 feet, which now permits vessels to sail in and out instead of being towed.

The existing appropriation is being applied to the protection of the timber work and to raising the jetties.

In order to give a channel 400 feet wide and 15 feet in depth at low-water, an additional expenditure of $291,766.42 will be required, which would be expended in widening and deepening the cut through the reef and in raising and extending the jetties. One hundred and fifty thousand dollars could be profitably expended in the coming year.

The appropriations to date have amounted to $555,000; amount expended to date, $526,089.74.

July 1, 1880, amount available	$35,050 00	
Amount appropriated by act approved March 3, 1881	33,000 00	
		$68,050 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	38,777 69	
July 1, 1881, outstanding liabilities	362 05	
		39,139 74
July 1, 1881, amount available		28,910 26
Amount (estimated) required for completion of existing project		291,766 42
Amount that can be profitably expended in fiscal year ending June 30, 1883		150,000 00

(See Appendix M M 2.)

3. *Sacramento River, California.*—A permanent system of improvement for the upper river would require the construction and maintenance of new banks, adjusted in position to the needs of navigation. The expense of such a system is not warranted at present. The treatment proposed, is to give the required depths as the necessity arises and to

keep the channel clear of snags. The lower river admits of permanent works of improvement.

Last year's expenditures were made in destroying snags, the construction of a permanent improvement at Fremont, and in the construction and equipment of a snag-boat. The depth at Fremont Bar was increased from 3 feet to 5½ feet, sufficient for the navigation of that part of the river. The snag-boat will be employed during the coming year in removing snags and other obstructions and in constructing brush dams as needed, particularly in the upper river. Three hundred and thirty-six snags were destroyed last year at a cost of $18,520.

The appropriation herein asked will be applied to the removal of snags, to the permanent improvement of the lower river, and to the temporary constructions on the bars of the upper river.

The total amount expended to the close of the present fiscal year is $105,467.83, a portion of which was applied to the Feather River.

July 1, 1880, amount available	$56,412 50	
Amount appropriated by act approved March 3, 1881	60,000 00	
		$116,412 50
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	61,808 91	
July 1, 1881, outstanding liabilities	4,071 42	
		65,880 33
July 1, 1881, amount available		50,532 17
Amount that can be profitably expended in fiscal year ending June 30, 1883		100,000 00

(See Appendix M M 3.)

4. *San Joaquin River, California.*—Projects for several detached improvements in different parts of the river and its connecting channels have been approved, but no survey or general project covering the whole river has been prepared.

The operations of the past year were directed to making two cut-offs in the narrows below Stockton. The operations of the coming year are the completion of the cut-offs, dredging in Mormon Slough, dredging in Stockton Slough, the destruction of snags in upper river, and the construction of dams to improve navigation on the upper river.

The appropriation now asked will be applied to dredging Mormon Slough, and at Oakland, and Twelve-Miles Slough, to an obstruction of the river at the cut-offs, if experience shall prove it to be necessary to further improvement of the navigation of the upper river, and to a survey of the river.

The expenditures of the past year were $8,077.25.

July 1, 1880, amount available	$20,611 77	
Amount appropriated by act approved March 3, 1881	40,000 00	
		$60,611 77
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	6,483 05	
July 1, 1881, outstanding liabilities	1,594 20	
		8,077 25
July 1, 1881, amount available		52,534 52
Amount that can be profitably expended in fiscal year ending June 30, 1883		50,000 00

(See Appendix M M 4.)

5. *Petaluma Creek, California.*—The original project was to give a depth of 3 feet at low-water to Petaluma and to make three cut-offs for the purpose of straightening the channel.

Two of these cut-offs were made during the year, to the very great improvement of the navigation, saving a day to each vessel. In addition, some dredging was done in the bed of the creek.

The total amount of excavation during the year was 21,135 cubic yards.

The amount now available is insufficient to afford any sensible relief from the difficulties that remain, and therefore it will be held unexpended to await the next appropriation, and will then be applied to dredging the bed of the creek below Petaluma.

The whole amount necessary to complete the project ($22,000) can be profitably expended in the coming year, and it is thought that the interests of the work require an appropriation of not less than $12,000.

The amount expended to June 30, 1881, is $7,547.66.

July 1, 1880, amount available	$8,000 00	
Amount appropriated by act approved March 3, 1881	8,000 00	
		$16,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		7,547 66
July 1, 1881, amount available		8,452 34
Amount (estimated) required for completion of existing project		22,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		22,000 00

(See Appendix M M 5.)

6. *Humboldt Bay and Harbor, California.*—The object of this improvement is to give a permanent depth of 10 feet at low-water in front of the town of Eureka in Humboldt Bay, and to secure a better and more stable channel over the bar at the entrance of the harbor. The latter is the more difficult as well as the more important object. No project or estimate has yet been submitted for the attainment of the latter result.

The first-named result is to be obtained by dredging. The first appropriation is now in hand and dredging will be commenced September 15, under a contract made on June 30.

The appropriation asked in this report will be applied to the same object.

Amount appropriated by act approved March 3, 1881	$40,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	7 82
July 1, 1881, amount available	39,992 18
Amount (estimated) required for completion of existing project	95,220 05
Amount that can be profitably expended in fiscal year ending June 30, 1883	50,000 00

(See Appendix M M 6.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

In compliance with requirements of the river and harbor act of June 14, 1880, Lieutenant-Colonel Mendell was charged with *such examinations and surveys as may be necessary to devise a system of works to prevent the further injury to the navigable waters of California from the débris from the mines and the estimates of the cost of such works, and report the result of such examinations, surveys, and estimates of cost of proposed works made in pursuance hereof to Congress at its next session*, and submitted a preliminary report upon the subject, which was transmitted to Congress at its last session and printed as House Ex. Doc. No. 76, Forty-sixth Congress, third session. (See, also, Appendix M M 7.)

And also with *examination to determine the work necessary to be done and the cost of the same to improve the channels inside the bar of Humboldt*

Bay, California, the results of which were transmitted to Congress in a report printed as House Ex. Doc. No. 59, Forty-sixth Congress, third session. (See, also, Appendix M M 6.)

Lieutenant-Colonel Mendell was also charged with the duty of making a report upon the subject of the following resolution of the House of Representatives of June 12, 1880, viz:

> That the Secretary of War be directed to report to this House what causes, if any, are tending to diminish the tidal area of the Bay of San Franicsco, and what action, if any, has been taken by the Government of the United States, by the city of San Francisco, or by corporations, or individuals which will tend to lessen the tidal scour on the bar of San Francisco, and thereby decrease the depth of water upon said bar, and diminish its value as a commercial harbor—

Which was transmitted to Congress and printed in House Ex. Doc. 93, Forty-sixth Congress, third session. (See, also, Appendix M M 8.)

Also, to comply with provisions of the river and harbor act of March 3, 1881, he is charged with the following, the results of which will be duly submitted when received:

1. *Mokelumne River, California, from its mouth at or near Woodbridge.*

IMPROVEMENT OF HARBOR AT SAN DIEGO, CALIFORNIA.

Officer in charge, Lieut. Col. C. S. Stewart, Corps of Engineers.

In 1875 a project was adopted for the improvement of this harbor by turning the course of the San Diego River from it by means of an artificial channel way and levee into False Bay, in which it emptied formerly. In this way it was believed the deposit in San Diego Harbor of the sand and earth brought down by the river during floods would be prevented. So far this has been the case.

Small repairs to the levee have been made during the past year.

The sum of $80,123 in all has been expended to the 30th of June, 1881.

The last appropriation made will probably keep the works in repair for several years.

July 1, 1880, amount available	$925 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	48 00
July 1, 1881, amount available	877 00

(See Appendix N N 1.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with provisions of the river and harbor act of March 3, 1881, Lieutenant-Colonel Stewart was charged with and has completed the following:

Harbor of San Luis Obispo, California. (See Appendix N N 2.)

IMPROVEMENT OF RIVERS AND HARBORS IN OREGON AND IN WASHINGTON TERRITORY—IMPROVEMENT OF LOWER CLEARWATER RIVER, IDAHO—CONSTRUCTION OF CASCADES CANAL, COLUMBIA RIVER.

Officer in charge, Maj. G. L. Gillespie, Corps of Engineers, having under his immediate orders Capt. Chas. F. Powell, Corps of Engineers, and since January 31, 1881, Lieut. P. M. Price, Corps of Engineers.

1. *Lower Willamette and Columbia rivers from Portland, Oregon, to the sea.*—The present project for the improvement of these rivers was adopted in 1877 and modified in 1879, the object being to deepen, permanently, the water over the main bars from Portland, on the Willamette,

to Columbia City, on the Columbia, for sea-going vessels and steamers drawing 20 feet or more, by the construction of a system of dikes and dams formed of piles and loose stone, which would utilize the available waters and currents of these rivers for scouring purposes.

The natural channel existing at the time the improvement was commenced, in 1867, varied from 150 to 300 feet, with not more than 15 feet at shoalest points at low tide, in low stage. The bars comprised in the project are located at Swan Island, near the head of Willamette Slough, and at Coon Island, Willamette River, and at Saint Helen's, Columbia River.

The pile dike began last year at the mouth of the Willamette River, to close Coon Island Slough, the western outlet to the Columbia River, was completed during the year, and the protective revetment around the island was heavily riprapped. Seven thousand two hundred and thirty cubic yards of material were dredged from the bar at the mouth of the Willamette (before improvement was completed), opening a channel 430 feet long and 110 feet wide with 19 feet at low stage, which has been maintained since the dike was finished.

Seven thousand three hundred and twenty cubic yards of material were dredged from the bar at Swan Island, Willamette River, opening a channel 2,640 feet long and 70 feet wide with 18 feet depth at mean low stage.

The right bank of Willamette Slough, below the dam built last season, was revetted to prevent further erosion.

Careful survey was made of the Hog's Back Shoal near Astoria, and the deep-water channel indicated for buoyage.

Minor surveys were made of the bars, at Martin's Island below Saint Helen's, Walker's Island below Kalama, and Saint Helen's, Columbia River, and of Swan Island Bar, Willamette River.

A careful survey was made of the Middle Sands at the entrance to the Columbia River, and of the channels over them, and a chart issued for the use of mariners.

The shore line of Point Adams was surveyed, and a fascine and sandbag revetment, 350 feet long, was built to protect Fort Stevens, on the west side, against damage by high seas.

Vessels and steam-propellers, drawing from 20 to 21 feet, have been able to reach Portland without detention during the year.

Amount appropriated from act June 23, 1866, to act March 3, 1881, both inclusive	$405,365 00
Amount expended to date	365,627 12

The amount available at this date will be applied in building and equipping a new dredger, and running the same during eight months of the next fiscal year, and in the purchase of materials for protection and preservation of existing works of improvement.

The appropriation of $100,000 recommended for fiscal year ending June 30, 1883, is proposed to be applied in building a submerged dam at the mouth of the Willamette, to close the eastern outlet to the Columbia River; in building a dike at Swan Island, Willamette River; in defraying running expenses of the dredger for one year; in building two scows for the dredger; in making surveys of bars, and purchasing materials for the repairs and preservation of existing improvements; and for contingent expenses of engineering.

July 1, 1880, amount available	$44,995 32	
Amount appropriated by act approved March 3, 1881	45,000 00	
		$89,995 32
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	45,960 05	
July 1, 1881, outstanding liabilities	4,297 39	
		50,257 44
July 1, 1881, amount available		39,737 88
Amount (estimated) required for completion of existing project		133,974 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		100,000 00

(See Appendix O O 1.)

2. *Upper Willamette and Yamhill rivers.*—The present project for this improvement was adopted in 1870, the object being to remove by a well-equipped snag-boat all snags and stumps which are found after each annual freshet grounded in the channel; to confine the river to the best channel by building low dams to close sloughs or contract water-way, and to scrape shoal bars to let steamboats of light draught pass freely over them.

Small sums have also been applied, from time to time, in blasting rocks at points where the channel was narrow and the passage dangerous.

During the year 1,021 snags have been removed, 374 trees cut from the banks, 600 linear feet of brush-dams built, and 10 days consumed in raking bars. In accomplishing this work the snag-boat has traveled 2,013½ miles.

Of solid rock 496.76 cubic yards have been removed by blasting at Rock Island Rapids near Oregon City, which has made the passage convenient and easy at lowest stage for river boats drawing not more than 2½ feet. At other points the channel varies from 80 to 100 feet in width, with a depth of not less than 20 inches at extreme low stage. This depth is all that boats need, as the freights at that stage are light and inconsiderable.

The amount expended to June 30, 1881, is $24,151.93.

The amount of $15,000 appropriated by act March 3, 1881, will be applied in continuing the use of the snag-boat for removing snags and cutting threatening trees from the banks; in lowering the crests of shoal bars by scraping, and in defraying contingencies of engineering.

The appropriation of $10,500 recommended for the fiscal year ending June 30, 1883, is for the annual expenses and repairs of the snag-boat, and for contingencies of surveys, engineering, and office expenses.

July 1, 1880, amount available	$18,373 16	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$33,373 16
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		24,151 93
July 1, 1881, amount available		9,221 23
Amount (estimated) required for completion of existing project		38,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		10,500 00

(See Appendix O O 2.)

3. *Upper Columbia River including Snake River.*—The present project for improvement of these rivers was adopted in 1877, the object being to afford in the Columbia River above the falls at the Dalles, a conveniently navigable channel through the various rocky reefs with a depth of 5½ feet at low-water, and in the Snake River as high up as Lewiston, Idaho, with a depth of 4½ feet at low stage. Between the reefs

which are from 10 to 40 miles apart in the Columbia, and closer in the Snake, the channel before improvements were commenced was usually wide and well defined, with deep water. At the reefs the river was choked with visible or sunken rocks, and the pilots picked their way by them, as well as they could, in channels often but little wider than the beam of their boats, with less than 4 feet depth of water.

Total amount appropriated	$190,000 00
Total amount expended to June 30, 1881	158,774 70

During the year a channel 200 feet wide with 4½ feet depth at low stage has been opened at Monumental Rapids, Snake River, and ten rocks have been blasted and removed in Texas Rapids in the same river, giving a navigable depth of 4½ feet in a channel 100 feet wide in the most difficult part.

This channel is capable of still further improvement. A contract was made November 15, for the removal of 100 cubic yards of rock at Umatilla Rapids, Columbia River, and 650 cubic yards of solid rock at Texas, Palouse and False Palouse rapids, Snake River.

The work was commenced under many difficulties at Palouse Rapids in December, but before anything beyond the removal of a few small bowlders in the north channel was accomplished, the contractor lost all of his plant by a sudden freshet in the river.

July 1, 1880, amount available	$31,955 18	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$46,955 18
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	13,819 86	
July 1, 1881, outstanding liabilities	1,710 00	
		15,529 86
July 1, 1881, amount available		31,425 32
Amount (estimated) required for completion of existing project		62,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		20,000 00

(See Appendix O O 3.)

4. *Constructing Canal around Cascades of the Columbia River, Oregon.*—The project for the improvment of the navigation of the Upper Columbia by the construction of locks around the Cascades, was adopted in 1877, the object being to afford a passage by river boats of the minor rapids of the Cascades by means of a canal with two combined locks having 8 feet over the lower miter-sill at dead low-water. Detailed surveys of the river from the main rapids to below Bradford's Island, a distance of 4½ miles, were made during the year, together with observations of river phenomena, and the results presented for the consideration of a Board of Engineers which assembled November 10, 1880. The original plan was modified by the Board and the existing plan, which was adopted in 1880, provides for the improvement of the river for a low-water navigation to a stage not exceeding 20 feet above low-water, the construction of a single lock near the foot of the main rapids with a lift of 24 feet and an available interior dimension of 462 by 90 feet, to accommodate one boat and three barges at one lockage.

The amount expended to date is $398,873.95.

During the year the protective embankment to the canal prism has been carried 2 to 3 feet above the reference of the highest water of 1876, and has been prolonged beyond station 20 to near station 28, with a dry stone wall whose top has been stepped down from reference (134) to reference (126); the abutment of the right-wing wall has made a proper junction with the protective embankment and stone wall; a timber bulkhead has been built across the canal prism at station 28, to keep out backwater from the river below stage of 20 feet on nearest gauge; a frame bulkhead has been built at station, 18 + 75, to completely inclose the lock site; bowlder quarrying has been continued to provide stone for masonry, strip the sides of the canal prism and to correct currents outside and adjacent to embankments, and the prism excavation has been carried from station 7 to station 20 to 8 feet above grade, and that of the lock site to 16 feet above bottom.

The appropriation of $750,000 recommended is to be applied in continuing construction of the protective wall; wing wall and a portion of the masonry of the locks; the quarrying and dressing of stone; the excavation of the canal prism and the building of its revetment walls, and the continuation of the river improvement.

July 1, 1880, amount available	$117,116 60	
Amount appropriated by act approved March 3, 1881	100,000 00	
		$217,116 60
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	75,990 55	
July 1, 1881, outstanding liabilities	7,278 88	
		83,269 43
July 1, 1881, amount available		133,847 17
Amount (estimated) required for completion of existing project		1,224,337 70
Amount that can be profitably expended in fiscal year ending June 30, 1883.		750,000 00

(See Appendix O O 4.)

5. *Coos Bay Harbor*, *Oregon*.—The present project for the improvement of the harbor was adopted in 1879, the object being to prevent, by the construction of a jetty, accretion to the south end of the sand spit on the north side of the entrance, and to open and maintain a more direct course across the outer bar for sea-going vessels. The channel in the lower harbor is constantly shifting under the action of the northwest winds, which heap up the sands on the north side.

The timber jetty, which, at the opening of the fiscal year, had reached a completed length of 450 feet outwards from the 6-foot curve, was prolonged seaward 200 feet, and the inshore interval of 538 feet measured along the prolongation of the adopted line was almost entirely closed by the use of small timber cribs filled and covered with stone. It has been found impossible to sink any more cribs in extension of the jetty, owing to the strong currents in a channel-way where no slackwater ever exists, and plans are in force now for continuing the work by depositing stone at the outer end from dump cars running upon a tramway connecting the improvement with a stone quarry, which has been opened a short distance from the shore line.

During the winter the north spit at its southern end was partially cut away, the high-tide was thrown nearly 1,000 feet to the northward, and the outlet over the bar was more direct from the inside. As long as the southerly storms continued the depth on the bar gradually increased to 19 feet at high-water, but late in May, when the northerly winds began, this depth was reduced in places to 13 and 16 feet.

It is expected that when the jetty has reached a further extension of 1,000 feet the depth of 19 feet at high-water will be maintained.

The appropriation of March 3, 1881, will be applied to making part of this extension.

The appropriation of $60,000 is asked to continue the improvement.

July 1, 1880, amount available	$15,642 28	
Amount appropriated by act approved March 3, 1881	30,000 00	
		$45,642 28
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		28,879 47
July 1, 1881, amount available		16,762 81
Amount (estimated) required for completion of existing project		902,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		60,000 00

(See Appendix O O 5.)

6. *Lower Clearwater River, Idaho.*—The present project for the improvement of this river was adopted in 1878, the object being to open a navigable channel for rafts and small river boats, not less than 60 to 75 feet wide, with 4 feet at low stage, from Lewiston, Idaho, to the mouth of the North Fork, a distance of 40 miles.

But a small reach of the river has ever been navigated by boats, and at many points where reefs and cobble-stone bars occur the bowlders are so thickly distributed across the river that there is no safe channel through them even for rafts, with more than 1 to 2 feet at low stage. It is a mountain stream with a steep slope, and the rapids repeat themselves at close intervals. It has not been attempted to open the river at once to steamboat navigation, but only to do a little work at each of the rapids, so as to enable rafts to get out without breaking up. The depth sought at present is 2½ feet at low stage, to be eventually carried to 4 feet.

During the year a channel 170 feet wide with 2½ feet depth has been opened at Big Eddy Rapids by blasting and removing solid rock; at Kent's Chute, 50 feet wide with 3 feet depth, by removal of cobble-stone; and at the head of Reuben's Rapids, by blasting and removal of solid rock. The latter rapids have been much improved and no more work need be done there until the other rapids are improved. There is no appropriation available for continuing the improvement. The appropriation of $10,000 recommended for the fiscal year ending June 30, 1883, will, if granted, be applied to completing the improvement at the Big Eddy and Kent's Chute rapids, and in commencing an improvement at Saddle Back Rapids.

Estimate of original project of improvement	$34,424 00
Amount appropriated to date	10,000 00
July 1, 1880, amount available	5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	5,000 00
Amount (estimated) required for completion of existing project	24,424 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	10,000 00

(See Appendix O O 6.)

7. *Entrance to Yaquina Bay, Oregon.*—The present project for the improvement of this harbor was adopted in 1880, the object being to close the south channel by the construction of a jetty, 2,500 feet long, on the south side of the entrance, and to open and maintain the central channel with a depth of water on the bar of not less than 17 feet at high-tide. The north channel has many submerged rocks and shoal areas, which make it of dangerous navigation at all times. The central channel is the most direct one over the bar, and on account of its freedom from rocks, visible at and near low-water, has been selected for improvement.

The amount expended to June 30, 1881, is $26,360.44. The line of the proposed jetty runs directly into the ocean, and the work of construction is of the most difficult character. The expense attending the preparation of the working plant, the construction of the scows and the cribs, and the opening of quarries previously unknown, in a locality totally destitute of working facilities and supplies for laborers, has necessarily been very great. One crib has been sunk in 6 feet of water, and by the 5th of July it is expected that another will be in place. It will be attempted to hasten the inshore construction by the delivery of stone by a tramway 2,500 feet long, extending from a wharf on the inside of the harbor to the heel of the jetty, and thence over the jetty as it advances.

The currents are so strong and variable at the site that stone-scows cannot be handled with safety on the sea side of the improvement.

The appropriation asked for is to prolong the jetty commenced under the appropriation of June 14, 1880.

July 1, 1880, amount available	$40,000 00	
Amount appropriated by act approved March, 1881	10,000 00	
		$50,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	26,360 44	
July 1, 1881, outstanding liabilities	2,500 00	
		28,860 44
July 1, 1881, amount available		21,139 56
Amount (estimated) required for completion of existing project		415,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		60,000 00

(See Appendix O O 7.)

8. *Mouth of Coquille River, Oregon.*—The appropriation of $10,000, act June 14, 1880, is the only one made for the improvement. The present entrance to the river is filled with rocks from beyond the bar on the outside to a distance of one-half a mile inside, and the bar, which is composed of shifting sand, changes so rapidly under prevailing winds that it has been found impracticable to make a satisfactory improvement in the lower section of the river. The present project, which was adopted in 1880, has for its object the carrying of the lower reach of the river, terminating at Lewis Wharf, directly out to sea through the lower end of the present sand-spit on the north side by building a stone jetty on the left bank, running in a northwesterly direction, so that its extension will cut the southern edge of the north spit 800 feet to the southward of Rockliff Rocks. The channel to be formed will pass between the jetty and Rockliff Rocks. During the year 750 feet of jetty were built by sinking narrow boxes of timber, 30 feet long, which supported a tramway for the delivery of stone from a quarry opened on the left bank near the heel of the jetty, and then depositing stone on the sides and over the boxes until the mole so formed had reached a level of 2 feet above low-water line, with a crest varying in width from 5 to 8 feet, and a base 15 to 28 feet, according to the depths of water found along the adopted line. The jetty can be still further prolonged 100 feet before the exhaustion of the existing appropriation. It is designed to continue the construction until a channel is opened over the bar with a depth of 15 feet at high-tide. The jetty, as built, has already had the effect of causing the opposite spit to commence wearing away, and it is believed that an extension of 1,000 feet will completely destroy the southern end of the north spit, and go far towards maintaining an open channel across the bar in that direction.

The appropriation recommended is designed to be applied to the extension of the jetty commenced under the appropriation of June 14, 1880.

July 1, 1880, amount available	$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	6,712 43
July 1, 1881, amount available	3,287 57
Amount (estimated) required for completion of existing project	164,200 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	25,000 00

(See Appendix O O 8.)

9. *Cowlitz River, Washington Territory.*—The Cowlitz is the most important tributary of the Columbia River below the mouth of the Willamette; is 80 miles long, and navigable at ordinary stage for nearly 50 miles from its mouth by small steamboats.

The appropriation ($2,000) made by the act of June 14, 1880, was applied to defraying the running expenses of the snag-boat from October 12 to December 13, 1880, and to payment of necessary expenses of engineering and inspection. As the river is used by small river boats of not exceeding 2 feet draught, and as the obstructions to navigation consist of shoal gravel bars, in which are embedded great quantities of snags and drift, the project for the improvement has been limited to the annual removal of the most dangerous snags and the scraping of the bars to a moderate extent to enable the boats to get over them easily. During the year the operations of the snag-boat in removing snags, overhanging trees, and other obstructions, have enabled boats drawing 3 feet to reach, without trouble, Cowlitz Landing, 40 miles above the mouth, at lowest stage.

The river improvement is greatly benefiting the valley; a third steamboat for the river trade is building, and settlers are rapidly coming in to engage in agricultural pursuits.

The appropriation of $1,000, act of March 3, 1881, will be applied to defraying the expenses of the Willamette River snag-boat for a period of one month, when employed in removing the snags which have accumulated during the year.

The appropriation recommended for continuing the improvement during the fiscal year ending June 30, 1883, will, if made, be applied to operating the snag-boat for two or more months in clearing out the river, and in extending the low-water navigation 10 miles beyond the point reached by past improvements.

July 1, 1880, amount available	$2,000 00	
Amount appropriated by act approved March 3, 1881	1,000 00	
		$3,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,000 00
July 1, 1881, amount available		1,000 00
Amount (estimated) required for completion of existing project		2,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		2,000 00

(See Appendix O O 9.)

10. *Skagit River, Washington Territory.*—An examination was made of this river in 1874, to comply with the requirements of the river and harbor act of June 23, 1874, and it was estimated that the sum of $15,000 would be required to remove the rafts, jams, and snags which obstructed the navigation, and to protect the banks against the action of the currents.

By act of June 14, 1880, $2,500 was appropriated for improving the river, and applied to widening the channel 50 feet at Little Mountain by cutting the jam and removing snags, forming an improved channel 150 feet wide with 5 feet at low stage; in blasting a bowlder from the channel near Miller's Landing, giving a clear channel-way 200 feet wide, with not less than 4 feet at low stage; and in clearing a passage 50 feet wide with 8 feet depth at low stage through the jam at the head of the North Fork.

A part of the old jam at Mount Vernon should be removed, as it forms a nucleus for the collection of drift, and will in time, if not removed, form a raft of the magnitude of that existing in 1874, and, consequently, close the river.

With the amount recommended for the fiscal year ending June 30, 1883, if appropriated, it is proposed to build, equip, and run for one year a good snag-boat, which will be utilized not only in the Skagit River, but in all the rivers of Washington Territory emptying into the sound.

There are no railroads penetrating these valleys, and the officer in charge thinks it but just to the settlers that the rivers, their only means of communication with the markets for produce, be kept open to enable them to get out the valuable timber which covers the highlands.

The drainage basin of the Skagit alone contains 2,800 square miles, 200 square miles of which may be used for agricultural purposes.

July 1, 1880, amount available	$2,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	25,000 00

(See Appendix O O 10.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT.

To comply with requirements of the river and harbor act of March 3, 1879, Major Gillespie was charged with a *survey of the Columbia River at the Dalles, in Oregon, including plan and specifications for locks and canal around said point.* It is expected that a full report upon this proposed improvement will be received in time for transmission to Congress at the early part of the next session.

And to comply with provisions of the act of June 14, 1880, Major Gillespie was charged with and has completed the following, the results of which were transmitted to Congress and printed in Senate Ex. Doc. No. 39, Forty-sixth Congress, third session:

1. *Stillaquamish River, Washington Territory.* (See also Appendix O O 11.)
2. *Nooksack River, Washington Territory.* (See also Appendix O O 12.)
3. *Snohomish River, Washington Territory.* (See also Appendix O O 13.)
4. *Siuslaw Bay, Oregon.* (See also Appendix O O 14.)

And also to comply with provisions of the river and harbor act of March 3, 1881, he was charged with the following, the results of which will be duly submitted when received:

1. *Young's, Lewis' and Clarke's, and Skipanon Rivers, entering into Young's Bay, in the county of Clatsop, near mouth of Columbia River, Oregon.*
2. *Snake River, from Lewiston to the mouth of Salmon River, Idaho.*
3. *Entrance to Gray's Harbor, Washington Territory.*
4. *Between Baker's Bay and Shoalwater Bay, Washington Territory, for canal for light-draught vessels.*
5. *Survey of Chehalis River, in Washington Territory.*

HARBOR OF REFUGE ON THE PACIFIC COAST.

The river and harbor act of March 3, 1879, appropriates $150,000 to be expended by the Secretary of War in the commencement of the construction of a breakwater and harbor of refuge at such point on the Pacific Ocean between the Straits of Fuca and San Francisco, Cal., as may, in the opinion of a majority of the Board of United States Engineers for the Pacific Coast, be most suitable, the interest of commerce, local and general, being considered.

To comply with a resolution of the Senate of May 5, 1880, a majority and a minority report of the Board of Engineers, dated March 6, 1880, was transmitted to the Senate, May 8, 1880, and printed as Senate Ex. Doc. No. 188, Forty-sixth Congress, second session; and on May 24 there was also transmitted to Congress as an appendix to the above a letter from Assistant George Davidson, United States Coast and Geodetic Survey, in reply to a request from the Board asking the results of his observations and experience on the coast. As the selection of a site had been made by the Board before the receipt of this communication, it formed no part of the proceedings previously had. This letter was printed as Part 2 of the above congressional document. Subsequently, on June 3, another communication was received upon the same subject, also at the request of the Board, from Assistant A. F. Rodgers, of the United States Coast and Geodetic Survey. The Board also invited, by public notice in the journals of the coast, all persons who so desired to submit their views, either verbally or by letter.

As some of these communications were not received by the Board in time for consideration before its report on the location of the harbor of refuge was made, and in view of the magnitude of the work, the importance of the fullest discussion of the subject, and of the diversity of opinion which appeared to exist, in some instances at variance with the views of the majority of the Board, with the sanction of the Secretary of War instructions were given to the Board to reconsider the whole subject.

The Board accordingly, after further consideration, submitted its supplementary report, January 15, 1881, which was transmitted to the Senate in compliance with its resolution of February 19, and is printed as Senate Ex. Doc. No. 59, Forty-sixth Congress, third session.

It will be seen that this report is not a unanimous one; that the majority of the Board, having studied and carefully examined the papers before it and reconsidered the whole subject, sees no reason for changing the views expressed in its report of March 6, 1880, that Port Orford is the most suitable point for the proposed harbor of refuge.

It will also appear that the dissenting member adheres to his previously expressed opinion that Trinidad presents greater advantages than any other point, and reserves the right to present a full expression of his views at a later period.

It may be well to state that according to the estimates of the Board, an ultimate expenditure of about $8,000,000 will be involved in the complete establishment of the harbor in question. As it is evident that the expenditure of the amount now available cannot produce any beneficial results, it is proposed to withhold it till a further appropriation is made. This course will be in the interest of economy and will not delay the final construction of the harbor.

(See Appendix P P.)

SURVEYS AND EXAMINATIONS WITH A VIEW TO THE IMPROVEMENT OF RIVERS AND HARBORS.

For examinations and surveys for improvements and for contingencies of rivers and harbors, an appropriation of $200,000 should be made.

WASHINGTON AQUEDUCT.

Officer in charge, Lieut. Col. Thomas Lincoln Casey, Corps of Engineers.

The funds appropriated for the Washington Aqueduct for the past year, were for maintenance and general repairs of existing works. These have been kept in good order, and have furnished to the city as great a supply of water as they are capable of giving with the present appliances.

Among the larger repairs made during the past year, were the plastering, with Portland cement mortar, of the exterior walls of the influent and effluent gate-houses of the distributing reservoir; the construction of anew timber bridge, 143 feet in length, with a 16-foot roadway, supported on trestles from 15 to 21 feet in height, over the waste channel of the receiving reservoir; the raising of the masonry of the chamber of the connecting conduit at the receiving reservoir, so as to bring up the water in the distributing reservoir to the level of 146 feet; and the plastering, with Portland cement mortar, of the exterior of the high service reservoir in Georgetown, in imitation of a rustic ashlar covering for this structure.

The necessity for the extension of the dam at the Great Falls, across the river, is again urged, and attention is invited to the remarks of the officer in charge upon this matter. The appropriation required for this purpose is recommended to favorable consideration; for unless this dam is built, the annoyance and embarrassment which many of the people of this city experience in consequence of a weak and limited supply of water, will in a short time be seriously increased, while the areas of limited supply will correspondingly enlarge.

The estimates of the officer in charge for the fiscal year ending June 30, 1883, are as follows:

For engineering, maintenance, repairs, and construction	$255,000 00

(See Appendix Q Q.)

IMPROVEMENT AND CARE OF PUBLIC BUILDINGS AND GROUNDS IN THE DISTRICT OF COLUMBIA.

Officer in charge, Lieut. Col. Thomas Lincoln Casey, Corps of Engineers, from July 1, 1880, to April 1, 1881; since that date Col. A. F. Rockwell, U. S. A.

The labor performed during the year upon the public grounds in the District of Columbia was confined principally to their care and preservation, the available appropriations permitting but little advance in the way of new work. Satisfactory progress was, however, made in the improvement of the grounds south of the Executive Mansion, while a marked improvement was made in Farragut Square, by the removal of the concrete roadway therefrom. Eleven of the smaller reservations at the intersections of streets and avenues were also improved by regrading and planting, and inclosing with park post and chain fence, and the introduction of water-pipe for irrigating purposes.

Attention is invited to the detailed report of the officer in charge, and his estimates for the coming fiscal year are recommended as follows:

For improvement and care of public buildings and grounds	$193,500 00
For compensation of persons employed on and around public buildings and grounds	48,400 00
For contingent and incidental expenses	1,000 00
	242,900 00

(See Appendix R R.)

SALE OF LOTS AT THE INTERSECTION OF K AND SIXTEENTH STREETS, NORTHWEST, WASHINGTON, DISTRICT OF COLUMBIA.

Section 4 of "An act making appropriations for the expenses of the government of the District of Columbia for the fiscal year ending June 30, 1882, and for other purposes," approved March 3, 1881, provides—

> That the Chief of Engineers, United States Army, in charge of public buildings and grounds in the District of Columbia, be, and is hereby, authorized to sell and convey, by good and sufficient deed, to each of the owners of lot one, square one hundred and eighty-four; lot five, square one hundred and eighty-five; lots five, six, and seven, square one hundred and ninety-eight; lot twelve, square one hundred and ninety-nine, in the city of Washington, District of Columbia, such portion of the ground immediately adjoining the front of said lots, or either of them, as will make the angles at the four corners of Sixteenth and K streets, northwest, right angles, upon payment into the Treasury of the United States by said owners, or each of them, of an amount for the number of feet in each lot so to be conveyed at the rate the same may be appraised by three disinterested freeholders resident of the city of Washington, to be selected and sworn by said Chief of Engineers impartially to appraise said real estate at the true value thereof in money; and upon said sale, the owners of said lots respectively shall pay into the Treasury of the United States, for the erection of a high-school building in the city of Washington, one-third of said purchase money, and the remainder thereof, with interest, in one year from the date of sale. No conveyance shall be made until all the purchase-money is paid: *Provided*, That said Chief of Engineers shall not sell or convey one portion or any part of said real estate unless all the same is sold and conveyed.

In obedience to its requirements, the following-named gentlemen, residents of the city of Washington, D. C., were invited to act as appraisers at a compensation of $25 each, viz: Mr. C. C. Duncanson, Dr. Daniel B. Clarke, and Mr. O. C. Green.

Having signified their acceptance of the invitation, and taken the prescribed oath, the appraisers proceeded to the discharge of the duties imposed upon them, and under date March 31, 1881, submitted their report, of which the following is a copy:

WASHINGTON, *March* 31, 1881.

SIR: The undersigned having been appointed a commission, and having taken the necessary oath for the purpose of appraising the triangles at the intersection of Sixteenth and K streets northwest, said triangles adjoining squares 184, 185, 198, and 199, have personally visited, viewed, and walked over said ground and premises, and, after due consideration and consultation, make the following as their report:

We appraise the triangles adjoining squares 184, 185, and 199 at $1.50 per square foot. The triangle adjoining square 198 we appraise at $1.25 per square foot, it being in front of three lots, the center lot being occupied and improved by frame dwelling-house, which will not be so susceptible of receiving the same benefit, by the addition of the triangle, as the lots in squares 184, 185, and 199, which are unimproved.

All of which is respectfully submitted under our hands and seals.

DAN'L B. CLARKE. [SEAL.]
CHAS. C. DUNCANSON. [SEAL.]
O. C. GREEN. [SEAL.]

H. G. WRIGHT,
Chief of Engineers, Brig. and Bvt. Maj. Gen., U. S. A.

Under date April 1, 1881, the following letter was addressed to—

Mr. Sylvanus C. Boynton.
Messrs. Henry Dickson and others.
Messrs. John F. Cook and others.
Messrs. Henry Dickson and William King.

OFFICE OF THE CHIEF OF ENGINEERS, UNITED STATES ARMY,
Washington, D. C., April 1, 1881.

GENTLEMEN: In accordance with the provisions of section 4, of "An act making appropriations to provide for the expenses of the government of the District of Columbia for the fiscal year ending June 30, 1882, and for other purposes," approved March 3, 1881, I have caused an appraisement to be made of the triangular spaces abutting upon lot one, square 184; lot 5, square 185; lots 5, 6, and 7, square 198; lot 12, square 199, in this city (containing 1,296 square feet each), by three disinterested freeholders resident of the city of Washington, selected and sworn by me to "impartially appraise said real estate at the true value thereof in money"; and the said appraisers have reported to me that they have appraised the triangles adjoining squares 184, 185, and 199 at $1.50 per square foot, and the lot adjoining square 198 at $1.25 per square foot. It being understood that you are the owners of the lots in question I have to request that you will state in writing whether you will purchase the said lots from the United States at the prices fixed by the appraisers, also whether you will pay into the Treasury of the United States the entire sum fixed therefor, or will pay one-third down and the balance, with interest, within one year.

Your attention is invited to the provision contained in section 4. of the act, "that no conveyance shall be made until all the purchase money is paid: *Provided*, That said chief of engineers shall not sell or convey one portion or any part of said real estate unless all the same is sold and conveyed."

A copy of the report of the appraisers and of section 4 of the act referred to are transmitted for your information.

Very respectfully, your obedient serv't,

H. G. WRIGHT,
Chief of Engineers, Brig. and Bvt. Maj. Gen'l.

In reply thereto, each of the parties named signified their willingness to accept the appraisal of the commissioners and to pay for the lots in cash.

Upon the receipt from the Treasurer of the United States of his certificates that the several amounts due from the parties had been paid into the Treasury, proper deeds of conveyance were made.

The amounts received for the lots were as follows:

John F. Cook and others, square 198	$1,620
Henry Dickson and William King, square 185	1,944
Henry Dickson and others, square 199	1,944
Sylvanus C. Boynton, square 184	1,944

MISSISSIPPI RIVER COMMISSION.

This commission, organized under the provisions of the act of June 28, 1879, reports to and receives instructions from the Secretary of War through this office. In addition to the continuation of the surveys of this river and its tributaries, and the consideration of plans for improving and giving safety and ease to the navigation of the main stream, the commission has been engaged in making arrangements for the application of the appropriation of $1,000,000, made by the river and harbor act of March 3, 1881, to the improvement of the extensive reaches of the Mississippi River in the vicinity of Plum Point and Lake Providence, where some of the worst of the obstacles to the navigation of the lower river are met with.

Much detailed information regarding the progress of the commission in its duties will be found in its reports, Appendix S S, which are attached at the suggestion of the president of the commission.

SURVEYS OF THE NORTHERN AND NORTHWESTERN LAKES.

Officer in charge, Maj. C. B. Comstock, Corps of Engineers, who had under his immediate orders First Lieut. P. M. Price, Corps of Engineers (relieved from duty on Lake Survey December 7, 1880), and the following named principal assistant engineers, E. S. Wheeler, A. R. Flint, O. B.

Wheeler, R. S. Woodward, C. H. Kummell, Thomas Russell, J. H. Darling, T. W. Wright, and L. L. Wheeler.

Progress of the work during the year.—Longitudes have been determined between Detroit and the following named stations: Cambridge, Mass., Toledo, Ohio, Fort McDermit, Nev., and San Antonio, Tex.

The comparison of standards has been continued. The conduct of the zinc bar of Tube I., of the Repsold base apparatus, has been investigated.

The final reduction of the work of the lake survey and the preparation of the final report have been continued.

Water-level observations have been continued.

Coast chart No. 7 of Lake Erie has been completed.

Amount available for fiscal year 1881–'82	$26,000 00
Amount required for survey of northern and northwestern lakes, for fiscal year ending June 30, 1883, namely, for electrotyping 50 copper plates, for continuance of water-level observations, for printing and issuing charts for use of navigators, for office rent, reduction of work, clerk hire, fuel, and miscellaneous	20,000 00

(See Appendix T T.)

MILITARY, GEOGRAPHICAL, AND LAKE SURVEY MAPS.

In the Office of the Chief of Engineers.

Progress in the compilation of the new outline map of the Territory of the United States, west of the Mississippi River, scale $\frac{1}{2000000}$, has been made during the past year, and the northwestern sheet has been placed in the hands of the engraver.

The following maps have been photolithographed and an edition printed for distribution to the army:

Map of the Yellowstone National Park, Big Horn Mountains and adjacent territory, on a scale of 12 miles to 1 inch, by Capt. James F. Gregory, Corps of Engineers, 1881.

Map of Mexico, by Captain Noix, 1873, scale $\frac{1}{3000000}$.

Map of the United States, showing the locations of works and surveys for river and harbor improvement, on a scale of 52½ miles to 1 inch, by Maj. H. M. Robert, Corps of Engineers, 1879.

Map of the Yellowstone River, in thirty-three sheets, from Fort Keogh to Fort Buford, scale $\frac{1}{9600}$, by Lieut. Edward Maguire, Corps of Engineers, 1879.

The following maps are now in the hands of the photolithographer:

Map of Nebraska, scale $\frac{1}{625000}$, by Capt. W. S. Stanton, Corps of Engineers, 1881.

Map of the Department of the Columbia, scale 16 miles to 1 inch, by Lieut. T. W. Symons, Corps of Engineers, 1881.

Map of the Ohio River, in forty-one sheets, scale 3 miles to 1 inch, by Maj. W. E. Merrill, Corps of Engineers, 1881.

The following lake survey charts have been engraved on copper:

Lake Erie.
Lake Erie coast chart, No. 1.
Lake Erie coast chart, No. 5.
Lake Erie coast chart, No. 6.
Niagara Falls.

Lake Erie coast chart No. 7 has been photolithographed and an edition printed in advance of the engraved edition. This chart is now in the hands of the engraver.

Plates 14 to 22, to illustrate the final report of the Survey of the Northern and Northwestern Lakes have been photolithographed and printed.

The following engraved plates of charts of the Northern and Northwestern Lakes have been electrotyped:

Lake Ontario.
Lake Michigan coast chart, No. 1.
Lake Michigan coast chart, No. 2.
Lake Michigan coast chart, No. 3.
Lake Michigan coast chart, No. 8.
Lake Michigan coast chart, No. 9.
Lake Superior charts, Nos. 1, 2, and 3.
Isle Royale.
Lake Saint Clair.
Lake Erie coast chart, No. 2.
Lake Erie.
Lake Erie coast chart, No. 3.
Lake Erie coast chart, No. 4.
Lake Erie coast chart, No. 6.
Lake Ontario coast chart, No. 1.
Lake Ontario coast chart, No. 5.

GEOLOGICAL EXPLORATIONS OF THE FORTIETH PARALLEL.

The last of the quarto reports of this exploration, Vol. VII., Odontornithes, by Prof. O. C. Marsh, has been published.

GEOGRAPHICAL SURVEYS OF THE TERRITORY OF THE UNITED STATES WEST OF THE ONE HUNDREDTH MEIDIAN.

Officer in charge, First Lieut. M. M. Macomb, Fourth U. S. Artillery.

During portions of the year, in addition to the regular office force, the following gentlemen have been temporarily engaged upon special subjects: Prof. J. J. Stevenson, geologist, in completing the proof-reading of his report; Dr. C. A. White, paleontologist, in preparing an appendix to the above report, and reading proof of same; Mr. Miles Rock, computing geographical positions of main and secondary triangulation points in California and Nevada; Mr. Frank Carpenter, in completing the plotting of topographical data in Atlas sheet 73 in Southern California.

First Lieut. Willard Young, Corps of Engineers, U. S. A., was engaged at the office between June 7, 1881, and June 13, 1881, in supervising the plotting of notes taken by him in 1878 at Great Salt Lake.

No field-work was done during the year, there being no funds availble for that purpose.

The duties of the regular office force have been confined to the reductions needed to place data already gathered in shape for publication.

Twenty longitudes and latitudes of primary and secondary triangulation stations have been computed, together with 126 distances and 39 azimuths.

Plotting has been done upon 5 regular and special sheets, not yet ready for publication, and new material has been reduced for revised edition of atlas sheets out of print.

Six regular atlas sheets in hachures, one large topographical map of the Lake Tahoe region, and one outline map have been completed during the year and placed in the hands of the lithographer.

Five other atlas sheets are now in the hands of the final draughtsmen and will be completed during the next fiscal year, together with two others not yet taken up.

Four new land classification sheets and three new geological sheets are now in the hands of the lithographer.

No maps will accompany extra copies of appendix, there not being sufficient funds available for the publication of large editions.

Vol. VII., Archæology, of the quarto reports authorized by act of Congress, has been in stereotype for some time, and will appear during the present year.

Vol. III., Supplement, Geology, by Prof. J. J. Stevenson, is now passing through the press, and the manuscript of an octavo report containing tables of geographical positions, altitudes, &c., is in preparation.

A new edition of the list of maps and reports issued by the office of this survey has just passed through the press.

The maps now in preparation will be issued as rapidly as they can be completed by the present small force.

There are a number of atlas sheets, aggregating in area about 57,000 square miles and lying in Oregon, California, and Arizona, in which much field-work has already been done, but in which further field-work must be done before publication in regular form would be possible.

Lieutenant Macomb estimates that $40,000 could be used to advantage in permitting the filling of gaps in the triangulation and topography by additional field-work, thus enabling full benefit to be got from material already at hand.

His report with estimates and appendixes is appended.

(See Appendix U U.)

RECONNAISSANCES AND EXPLORATIONS.

The following-named officers have been on duty at the headquarters of the Army and at headquarters of the military divisions and departments, and have been engaged during the year in preparing such maps and making such surveys and reconnaissances as were required by their respective commanding officers:

Maj. O. M. Poe (colonel and aid-de-camp to the General of the Army) at headquarters of the Army.

Capt. James F. Gregory at headquarters Division of the Missouri.

Capt. W. R. Livermore at headquarters Department of Texas.

Capt. W. S. Stanton at headquarters Department of the Platte.

Capt. E. H. Ruffner at headquarters Department of the Missouri till February 5, 1881.

Lieut. T. N. Bailey at headquarters District of New Mexico, from September 15, 1880, to February 23, 1881, and at headquarters Department of the Missouri since March 28, 1881.

Capt. Edward Maguire at headquarters Department of Dakota.

Capt. W. A. Jones at headquarters Division of the Pacific.

Lieut. Carl F. Palfrey at headquarters Department of Arizona.

Lieut. T. W. Symons at headquarters Department of the Columbia.

The maps prepared by these Engineer officers are of great value to the War Department and to the Army in the movement of troops, the establishment of posts for controlling the Indians and for protecting settlers. There is also a great demand for the maps from citizens for use in the location of railroads, mines, and valuable lands. It is especially desired that funds be supplied to enable the Engineer Department to continue the mapping of the areas which are likely to be traversed by troops or by hostile Indians in future campaigns. The small appropriation asked for the next fiscal year will provide for the collection, plotting, and publication of a large amount of data required for the use of the War Department.

The attention of the honorable Secretary of War is earnestly invited to this subject.

Maj. O. M. Poe, Corps of Engineers, U. S. A., Colonel and aid-de-camp, has been on duty as aid-de-camp to the General of the Army and as a member of the Light-House Board.

He has completed the compilation of a map illustrating the capture of Savannah, December 21, 1864, and has made progress on other maps illustrating the operations of the armies commanded by General Sherman in 1864 and 1865.

He also made a tour of examination in Texas and part of New Mexico with reference to probable railroad, especially towards the Mexican frontier, and the changes in the military situation which would arise therefrom. The letter of instructions under which he acted and his report submitted to the General of the Army are given in Appendix V V.

Capt. James F. Gregory, on duty at headquarters Military Division of the Missouri, reports that the work of his office during the past fiscal year has consisted in correcting, mounting, and issuing maps for the use of officers in the division; in making copies, tracings, reductions, and enlargements of maps of military reservations, scouts, reconnaissances, &c., for file and for forwarding.

A map of the Yellowstone National Park, Big Horn Mountains, and adjacent territory has been compiled and drawn to a scale of 1 inch to 12 miles. This map, 26 by 16 inches, has been published in this office, and is ready for issue.

Sixteen autograph plates of military reservations and posts in the Department of Dakota have also been prepared for issue.

Captain Gregory states that owing to the lack of funds for employment of a draughtsman and the reduction of his force of topographical assistants from two to one by General Orders No. 7, A. G. O., headquarters of the Army, January 13, 1881, the work of his office cannot be conducted in such a manner as to make it of the value it should be in the administration of the affairs of the division.

(See Appendix W W.)

Capt. W. S. Stanton, on duty with the general commanding the Department of the Platte, reports that a map of Nebraska has been made on a scale of 1: 500,000, embodying the fullest and latest information attainable from all reliable sources, embracing all surveys in the State, both under the Interior and War Departments, as well as a large mass of information secured from county officers, postmasters, and persons most familiar with the geography of the State.

Plans of all the posts in the department, with plots of their reservations, have been made in duplicate, comprising 50 sheets of drawings, with long inscriptions, embodying full information regarding both posts and reservations.

Five military reservations have been surveyed, and reconnaissances have been made of about 500 miles of routes.

One hundred and forty copies of large War Department maps have been mounted and issued, and the usual routine work of the office performed during the year.

(See Appendix X X.)

Lieut. T. N. Bailey, engineer officer at headquarters, Department of the Missouri, has made complete surveys of the military reservations at Fort Lewis, Rio de la Plata, Colo.; Fort Cummings, N. Mex.; and Fort Bliss, Tex., and a reconnaissance covering 2,500 square miles north and west of the latter fort.

From astronomical observations and direct measurements he reports the geographical positions of Fort Bliss, Tex., and Fort Leavenworth, Kans.

Office work has consisted in reduction of his field notes, compilation of scout reports, and duplication and issuing of various maps required for file, and the use of troops in the field.

(See Appendix Y Y.)

Capt. Edward Maguire, at headquarters, Department of Dakota, reports that the reservation of Fort Assinaboine, Mont., 869.82 square miles, was surveyed, and the boundary lines established. The latitude and longitude were determined by sextant observations at the post, and by transit observations in Saint Paul. The latitude and longitude of Fort Meade, Dak., were determined by an accurate connection with the site of the old post-office in Deadwood, the position of which had been determined by Capt. W. S. Stanton, Corps of Engineers.

The longitude of Carleton College Observatory, Northfield, Minn., and the latitude and longitude of Fort Randall were also determined. In addition, a portion of the engineer force was called upon for a great deal of work in laying out parade grounds, carriage roads, &c., at Fort Snelling, under the direction of the Quartermaster's Department.

The office work consisted in computing and plotting field notes, revising and correcting the maps of Montana and Dakota, in making tracings and photographic copies for forwarding and for file, and in supplying such information and data as were called for by the department commander and other officers.

(See Appendix Z Z.)

Capt. William A. Jones, engineer officer, headquarters Military Division of the Pacific and Department of California, reports that operations have been directed to the following purposes:

The survey of military posts and reservations.
Surveys for public buildings and works for water supply.
The collection of geographical information
The cartographic work connected with the foregoing.
The distribution of maps and geographical information.

The collation of information obtained by reconnaissances of troops in the field.

The following has been accomplished:

Surveys.

Post of Fort Point, Cal. To locate junction of Cherry street, San Francisco, with Presidio Reservation.

New graded roads on Presidio Reservation.

New road at Fort Point, Cal.

To establish boundaries of reservation at Fort Bidwell, Cal.

New graded road from Fort Point to First avenue, San Francisco, Cal.

For base lines for battery firing at Fort Point, Cal.

Boundaries of Marine Hospital Reservation, San Francisco, Cal.

Road from Marine Hospital to First avenue, San Francisco, Cal.

East, south, and west boundaries of reservation, Fort Point, San José, Cal.

For rifle range at Fort Point, Cal.

For site for anemometer on rifle range Presidio of San Francisco, Cal.

Astronomical.

Latitude and telegraphic longitude of Fort McDermit, Nev., determined, and observations made for determining telegraphic longitude of Spokane Falls and Colfax, W. T.

Examinations and reports.

On water supply at Angel Island, Cal.

On title to United States lands in the city of Monterey, Cal.

On quarry at site of proposed redoubt near Fort Point, Cal.

On title of the United States to the Warren Matthews farm at Fort Independence, Cal.

On case of discrepancies between the military and land office surveys at Fort Halleck, Nev.

On name given by early Spanish colonists to point of land at entrance to San Francisco Harbor, now known as Fort Point.

Examination of case of trespass and riparian rights at Fort Halleck, Nev.

On site for telegraph cable to Alcatraz and Angel Islands, Cal.

On altered boundaries of reservation at Fort Bidwell, Cal.

Cartographic.

37 copies, maps, plans, and sketches prepared.

Photographic.

693 copies, maps, plans, and sketches prepared.

Map-mounting.

129 copies maps and plans have been mounted.

Tracings.

33 tracings of maps and plans have been prepared.

(See Appendix A A A.)

Lieut. Carl F. Palfrey, engineer officer at headquarters Department of Arizona, reports the following work completed:

Field-work.

Examination of Apache-Thomas wagon-road and trail.

Examination of Upper Chino Valley with reference to location of military post.

Reconnaissance in Southeastern Arizona with reference to wagon and rail communication and location of military post.

Examination of freight-route from military posts to Atlantic and Pacific Railroad.

Reconnaissance of land occupied by Ava Suppai Indians.

Full topographical notes of 530 miles of road and trail.

Notes by time and compass, with itinerary, of 2,174 miles of road and trail.

Odometer measurement, 462.5 miles.

Office-work.

Road-maps, scale 1 inch to 6 miles:
    No. 1, latitude, 30° 30′ to 32° 45′; longitude, 107° 30′ to 111°.
    No. 2, latitude, 32° 30′ to 34° 45′; longitude, 108° 30′ to 112°.
Special plates of roads, scale 1 inch to 1½ miles:
  Verde-Apache road and trail.
  Apache-Thomas road and trail.
  Phoenix-Prescott, two roads.
  Prescott-Lee's Ferry, one route, road, and trail.
  Plats of posts and miscellaneous drawings, 15 sheets.
Photographic printing, 34 sheets.
Maps mounted:
    For office, 33.
    For field, 106.
Maps issued, 117.
Maps received, 2.

(See Appendix B B B.)

Lieut. Thomas W. Symons, at headquarters Department of the Columbia, reports that the first duty assigned to him during the past year was to find, lay out, and mark, if possible, a practicable wagon road from Camp Chelan to the Northern Pacific Railroad. This was done, a good route found, laid out, and marked.

Camp Chelan being deemed too inaccessible it was ordered abandoned and Lieutenant Symons assisted in finding the location for a new post near the Big Bend of the Columbia, now known as Camp Spokane.

The journeys necessitated by these duties enabled surveys of large portions of country to be made which had hitherto been unmapped, and which have been compiled on the maps of the department.

Dissatisfaction having been expressed at the location of Fort Lapwai and Camp Howard, Lieutenant Symons was ordered on a board to endeavor to find a site for a post which would combine and render unnecessary these two. He was unsuccessful in finding a proper site. A general survey was made of the quadrilateral of country formed by the Snake, Clearwater, and Salmon Rivers.

Trouble having arisen with the Skagit River Indians, Lieutenant Symons was appointed acting aid-de-camp by General Howard, department commander, given an escort of Captain Jocelyn's company, Twenty-first Infantry, and ordered to proceed to the scene of trouble, investigate, protect the people, and report. This he did, having a conference with the Indians, and, inducing them to accede to the demands made upon them, thus averted further trouble.

Lieutenant Symons submits a report of Lieut. W. C. Brown, First Cavalry, concerning the surveys made by him and assistants while on a scout from Walla Walla to Pend d' Oreille Lake and Grand Ronde and Wallowa Valleys.

Surveys were made of the reservations required for Fort Cœur d'Alene and Camp Spokane, by Assistant Engineer W. T. Webber, and maps and reports sent to Washington asking that the reservations be declared.

Compilations were made of the recent Land Office surveys in Oregon and Washington by Mr. Fred. N. Pendleton.

A great deal of new information was added to the eight-mile sheets of the department, gathered from surveys in the field, railroad and land offices, scouts, consultations, &c.

A department map, on a scale of 16 miles to the inch, was finished by Lieutenant Symons and sent to this office for approval and publication. The map will soon be published.

A pamphlet was compiled and published by Lieutenant Symons, giving a great deal of information about the posts in the department and 66 tables of distances between the most important places in the department, and a skeleton map showing the routes given in the tables.

Maps of the Spokane Indian Reservation were prepared and used in getting this reservation declared for the Indians.

A new survey of the western boundary of the Vancouver Military Reservation was made in connection with the town authorities.

Lieutenant Symons has been engaged during the latter part of the fiscal year just passed in making astronomical observations to establish the latitude and longitude of points in the department.

(See Appendix C C C.)

ESTIMATE FOR AMOUNT REQUIRED FOR MILITARY SURVEYS AND RECONNAISSANCES IN MILITARY DIVISIONS AND DEPARTMENTS.

For military surveys, reconnaissances, and surveys of military reservations by the engineer officers attached to the various headquarters of military divisions and departments, being an average of $5,000 for each of the nine military divisions and departments west of the Mississippi River, and $5,000 for publication of maps; total, $50,000.

OFFICE OF THE CHIEF OF ENGINEERS.

In the labors of the office the Chief of Engineers was assisted, on the 30th June, by the following officers in charge of the several divisions:

FIRST AND SECOND DIVISIONS.—*Fortifications, Battalion and Engineer depot, Lands, Armaments, Personnel, &c.*, Maj. George H. Elliot.

THIRD DIVISION.—*River and Harbor Improvements, &c.*, Lieut. Col. John G. Parke.

FOURTH AND FIFTH DIVISIONS.—*Property, Accounts, Estimates, Funds, Survey of the Lakes, Explorations, Maps, Instruments, &c.*, Capt. Henry M. Adams.

Very respectfully, your obedient servant,

H. G. WRIGHT,
Chief of Engineers,
Brig. and Bvt. Major-General.

Hon. ROBERT T. LINCOLN,
Secretary of War.

STATEMENT SHOWING THE RANK AND THE DUTIES OF OFFICERS OF THE CORPS OF ENGINEERS DURING THE FISCAL YEAR ENDING JUNE 30, 1881.

RANK AND NAME.	DUTIES.
BRIGADIER-GENERAL AND CHIEF OF ENGINEERS.	
Horatio G. Wright...... *Bvt. Major-General.*	In command of the Corps of Engineers and in charge of the Engineer Department. Charged with the supervision of such matters connected with construction of jetties and other works at South Pass, Mississippi River, as require the action of the Secretary of War. Member of Commission on repavement of Pennsylvania Avenue, Washington, D. C.; of Joint Commission to supervise the construction of the Washington National Monument, and of Light-house Board. Directed by the President to coöperate with the authorities of the State of New York in examining and deciding upon exterior pier and bulkhead lines on Hudson River from State dam at Troy to the city of Hudson.
COLONELS.	
John G. Barnard........ *Bvt. Major General.*	Member of The Board of Engineers. Retired from active service, to date from January 2, 1881.
Henry W. Benham...... *Bvt. Major General.*	In charge of the construction of forts Winthrop, Independence, and Warren, Mass.; work on Long Island Head, and field works on the coast from Provincetown to Gloucester, Mass.; forts Montgomery, Columbus, Wood, and Hamilton, and additional batteries, Castle Williams, South Battery Governor's Island, Mortar Battery at Fort Hamilton, N. Y., and Fort at Sandy Hook, N. J. Member of Boards of Officers of Engineers at New York City for the Examination of Officers for promotion in the Corps of Engineers.
John N. Macomb	In charge of the construction of forts Delaware, Del., and Mifflin, Pa., battery at Finn's Point, N. J., and work opposite Fort Delaware, Del. In charge of the improvement of the harbors at New Castle and Wilmington, Del., Chester, Pa., and at other places on Delaware River and Bay; ice harbor at Marcus Hook, Pa.; piers of ice harbor at New Castle, Del., and of the construction of pier at Lewes, Del. In charge of the improvement of the Salem River and Cohansey Creek, N. J.; Delaware and Broadkiln rivers, Duck and Mispillian creeks, Del., and Schuylkill River, and Susquehanna River from Richard's Island up, Pa.; and Delaware River below Bridesburg, Pa.; between Bridesburg and Trenton; near Cherry Island Flats, and at Schooner Ledge; Rancocas River, N. J.; Chester Creek, Pa.; Christiana River and deepening channel and improving harbor of same, from Delaware River to and above the city of Wilmington; and Saint Jones River, Del. In charge of removal of obstructions from the harbor at the Delaware Breakwater. In charge of the surveys of Delaware River below League Island, and examination or survey of Rancocas River from the Delaware River to Pemberton and Absecom Inlet, N. J.; ice harbor at the head of Delaware Bay, near Morris Liston's on Reedy Island; Delaware River, Chester and Ridley creeks near outlets in Delaware River, Pa.; Appoquinimink Creek, Del., Saint Jones Creek and Little Creek, in Kent Co., Del., Christiana River, Del., from Delaware Railroad bridge to mouth; Frankford Creek,

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
COLONELS. (continued.)	Five-Mile Point, Delaware River; mouth of the Mispillion, Del.; Newton and Mantua creeks; Maurice River; Salem and Cohansey rivers, N. J.; Murder Kiln, harbor at Delaware Breakwater, and Indian River, Del. Chairman of Commission Advisory to Board of Harbor Commissioners of Philadelphia.
Z. B. Tower *Bvt. Major General.*	President of The Board of Engineers. Member of Board of Engineers on improvement of Charleston Harbor, S. C.; of Board of Engineers on improvement of Pass Cavallo Inlet, Aransas Pass and Bay, and entrance to Galveston Harbor, Tex., and of Board of Engineers upon the further improvement of Savannah River and Harbor, Ga.; of Boards of Officers of Engineers at New York City for the Examination of Officers for promotion in the Corps of Engineers; of Board of Officers on inventions of heavy ordnance and improvement of heavy ordnance and projectiles, &c., in accordance with act of Congress approved March 3, 1881.
John Newton *Bvt. Major General.*	Member of The Board of Engineers. In charge of the improvement of the harbors at Rondout and Port Chester, N. Y., and of Echo Harbor, N. Y. In charge of the improvement of the Hudson River, Harlem River, Flushing, Sheepshead, and Canarsie bays, East Chester and Newtown creeks, and Buttermilk Channel, N. Y.; South and Raritan rivers and Cheesequakes Creek, N. J.; removal of obstructions in the East River, including Hell Gate, N. Y.; Sumpawaums Inlet, harbor of New Rochelle, N. Y., and deepening and widening channel in Gowanus Bay and the harbor of New York. In charge of the examination or survey of New Rochelle Harbor, N. Y., from City Island to town of New Rochelle, Bronx River from its mouth in the city of New York, Hempstead Harbor and Sumpawaums Inlet, Long Island, N. Y.; for waterway connecting Jamaica Bay with Cornell's Landing, N. Y.; Gowanus Bay and Patchogue River, N. Y.; of Harlem River, and through Harlem Kills to East River. In charge of the manufacture and supply of mastic, and examination of the Brooklyn Bridge. Member of Board of Engineers on improvement of Charleston Harbor, S. C.; of Board of Engineers on improvement of Pass Cavallo Inlet, Aransas Pass and Bay, and entrance to Galveston Harbor, Tex.; of Board of Engineers upon the further improvement of Savannah River and Harbor, Ga.; and of Court of Inquiry upon Lieutenant Colonel *Warren's* conduct as Major General commanding the Fifth Army Corps at battle of Five Forks, Va., on April 1, 1865. Directed by the President to coöperate with the authorities of the State of New York in examining and deciding upon exterior pier and bulkhead lines on Hudson River from State dam at Troy to the city of Hudson.
George Thom *Bvt. Brig. General.*	In charge of the improvement of the harbors at Belfast, Portland, Rockland, Richmond's Island, Me., Portsmouth, N. H., Newburyport, Boston (including sea-walls on Point Allerton, Great Brewster Island, Lovells' Island, Long Island Head, Rainsford Island, and Deer Island; also channel leading into Nantasket Beach), Plymouth, Provincetown, and Scituate, Mass.; Moose-a-bec Bar at Jonesport, and Richmond Harbor, Me. In charge of the improvement of the rivers Penobscot (at Bangor and

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
COLONELS. (continued.)	Bucksport Narrows), Cathance, Back (at "Gut" opposite Bath), and Kennebunk, Me., Exeter, N. H., Merrimac, Mystic, and Charles, Mass., Lubec Channel, Me., and Lake Winnipiseogee, N. H., Lamprey River, N. H., and repairing breakwater on the St. Croix River near Calais. In charge of the examination and survey of Aroostook River, Me., from boundary line to Masardis, Richmond Harbor on Kennebec River, and Mouth of Narragaugus River at Milbridge, Me., and Malden River, Mass.; to deepen the channel of Harrisecket River from Weston's Point, &c., Me.; Harbor of Brunswick; Lynn Harbor, Mass., and Merrimac River, Mass. and N. H.
William F. Raynolds ... *Bvt. Brig. General.*	On detached service; Engineer 4th Lighthouse District. Commissioned Colonel, Corps of Engineers, to date from January 2, 1881.
LIEUTENANT-COLONELS.	
Charles S. Stewart......	In charge of the construction of fortifications at Fort Point, Point San Jose, and Angel Island, in San Francisco Bay, and at San Diego, Cal. In charge of the improvement of the harbor at San Diego, Cal. In charge of the examination and survey of harbor at San Luis Obispo, Cal. Senior Member of Board of Engineers for the Pacific Coast. Member of Board of Officers of Engineers at San Francisco, Cal., for the examination of First Lieutenant *Powell* for promotion.
Charles E. Blunt .... *Bvt. Colonel.*	In charge of the construction of forts Gorges, Preble, Scammel, Popham, Knox, and Battery at Portland Head, Me., and forts Constitution and McClary, and batteries on Jerry's Point and Gerrish's Island, Portsmouth Harbor, N. H. Engineer 1st and 2d Lighthouse Districts.
James C. Duane .... *Bvt. Brig. General.*	On detached service; Engineer 2d and 3d Lighthouse Districts.
Robert S. Williamson ...	Member of Board of Engineers for the Pacific Coast. Member of Board of Officers of Engineers at San Francisco, Cal., for the examination of First Lieutenant *Powell* for promotion. Engineer 12th Lighthouse District.
Quincy A. Gillmore ..... *Bvt. Major-General.*	In charge of the construction of forts Wadsworth, Tompkins and its batteries. N. Y., Macon and Caswell, N. C., Moultrie, Sumter, Johnson, and Castle Pinckney, S. C., Jackson and Pulaski, Ga., Clinch and Marion, Fla., and in charge of forts Monroe and Wool, Va. In charge of the improvement of the harbors at Charleston, S. C., Savannah, Darien, and Brunswick, Ga. In charge of the improvement of Ashley River and Sullivan's Island, S. C.; of the bar at the mouth of Saint John's River, and of the inside passage between Fernandina and Sanit John's, Fla., Volusia Bar, Fla., Cumberland Sound, Fla. and Ga., Savannah River, Saint Augustine Creek, Ga., and Wappoo Cut, S. C., and Altamaha River, Ga. In charge of the examination or survey of Edisto and Salkiehatchie rivers, Wappoo Cut, and opening of a ship-canal across the Charleston Neck, S. C.; for reopenig of Santee Canal; Savannah River from Savannah to Augusta, Altamaha River, and Canoochee River, Ga.; Romney Marsh near Doboy, and the mouth of Jekyl Creek; opening of steamboat communication from the Saint John's River, Fla., by way of Topo-

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
LIEUTENANT-COLONELS. (continued.)	kalija Lake, to Charlotte Harbor or Pease Creek; Savannah Harbor and River, Ga., and Indian River, Fla. Member of Commission on repavement of Pennsylvania Avenue, Washington, D. C.; of Board of Engineers on improvement of Charleston Harbor, S. C.; of Board of Engineers for improvement of Pass Cavallo Inlet, Aransas Pass and Bay and entrance to Galveston Harbor, Tex.; of Board of Engineers upon the further improvement of Savannah River and Harbor, Ga. Member and President of "The Mississippi River Commission," created by act of Congress approved June 28, 1879.
Thos. Lincoln Casey *Bvt. Colonel.*	In charge of Public Buildings and Grounds and certain Public Works in the District of Columbia; of the construction of the building for the State, War, and Navy Departments; of the Washington Aqueduct, and the construction of the Washington National Monument. Member of Advisory Board to make and carry out changes and alterations in heating, lighting, and ventilating the Hall of the House of Representatives; and of Board to supervise the fire-proof reconstruction of the Patent Office Building; of Board of Officers to inspect and decide upon the proper execution of the contract for putting a fire-proof roof on the Government building at corner of Seventeenth and F streets, Washington, D. C.
Nathaniel Michler *Bvt. Brig. General.*	In charge of the improvement of the harbors of Plattsburgh, N. Y., Burlington and Swanton, and Otter Creek, Vt. In charge of the improvement of the Shrewsbury, Rahway, Elizabeth, Manasquan, and Passaic rivers, and Woodbridge Creek, N. J.; and of improvement of channel between Staten Island and New Jersey; Raritan Bay, N. J., from Perth Amboy and South Amboy to main ship-channel off Great Kills; Mattawan Creek, N. J.; and Ticonderoga River, N. Y. In charge of removal of wreck of the Dutch bark Samarang sunk off Sandy Hook Bar. In charge of the examination or survey of Mattawan Creek from Raritan Bay channel to Central Railroad bridge; Shark River, Perth and South Amboy to main ship-channel off Great Kills, Raritan Bay, N. J.; and Ticonderoga River, N. Y.; harbor at Port Henry, on Lake Champlain, New York Bay, between Sandy Hook and Coney Island Point; channel between islands of North Hero and South Hero, Lake Champlain; from a point between Ellis Island and the docks of New Jersey Central Railroad to a point between Robbins' Reef Light and Constable Hook, New York Bay, N. J.
John G. Parke *Bvt. Major-General.*	In charge of the 3d Division, Office of the Chief of Engineers.
Gouverneur K. Warren *Bvt. Major-General.*	In charge of the construction of defenses of New Bedford Harbor, Mass., and Narragansett Bay, R. I. In charge of the improvement of the harbors of Nantucket, Hyannis, and Wood's Holl, Mass., and Block Island and Newport, R. I., and Wareham, Mass. In charge of the improvement of the rivers Taunton, Mass., Pawtucket and Providence, R. I., and Connecticut, Mass. and Conn.; Narragansett Bay, R. I., and Little Narragansett Bay, R. I. and Conn.; and Potowomut River, R. I. In charge of the examination or survey of Wareham Harbor, Mass., and Potowomut River, R. I.; Edgartown Harbor and South Beach, Mass., and Buzzard's Bay and Barnstable Bay, Mass., at entrance of the proposed Cape Cod Canal. Member of Board of Engineers upon bridging the Ohio River.

***Statement showing rank and duties of officers of Corps of Engineers*—Cont'd.**

RANK AND NAME.	DUTIES.
LIEUTENANT-COLONELS. (continued.)	
George H. Mendell...... *Bvt. Colonel.*	In charge of the construction of fort on Alcatraz Island, and of defenses at Lime Point, San Francisco Bay. In charge of the improvement of the harbor at Oakland, Cal.; of the construction of the breakwater at Wilmington Harbor, Cal., and improvement of Humboldt Harbor and Bay. In charge of the improvement of Sacramento and San Joaquin rivers and Petaluma Creek, Cal. In charge of removal of wreck of the bark Adelaide Cooper, lying near entrance to Wilmington Bay, Cal. In charge of the examination or survey of Sacramento River and Humboldt Bay, Cal.; to devise a system of works to prevent further injury to navigable waters of California from the débris from the mines, with estimates of the cost of such works; of Mokelumne River, Cal., from its mouth at or near Woodbridge; to investigate causes tending to decrease depth of water and diminish the commercial value of San Francisco Harbor. Member of Board of Engineers for the Pacific Coast and of Advisory Board of Commissioners on the Harbor Lines of San Francisco. Member of Board of Officers of Engineers at San Francisco, Cal., for the examination of First Lieutenant *Powell* for promotion.
Henry L. Abbot......... *Bvt. Brig. General.*	Member of the Board of Engineers. In charge of the construction of Fort Schuyler and fort at Willets Point, N. Y., and of experiments with torpedoes. Commanding Engineer Depot and Post of Willets Point, and Battalion of Engineers. Member of Boards of Officers of Engineers at New York City for the Examination of Officers for promotion in the Corps of Engineers. In charge of establishment of grade lines of the parade ground at Davids Island, New York Harbor.
William P. Craighill....	In charge of the construction of defenses of Baltimore, Md., and Washington, D. C. In charge of the improvement of the harbors at Baltimore, Annapolis, Queenstown, and of the inner harbor at Cambridge, Md., and Onancock Harbor, Va. In charge of the improvement of the channel of Susquehanna River above and below Havre de Grace, and work at the Fishing Battery light station near Spesutia Island; of the Chester, Wicomico, Pocomoke, Elk, Northeast, and Choptank rivers, Treadhaven and Secretary creeks, Md.; Broad Creek, Del., James and Appomattox rivers, Va., New River, Va. and W. Va., Great Kanawha, Shenandoah, and Elk rivers, W. Va., and Cape Fear River, N. C.; water-passage between Deal's and Little Deal's Islands, Md. In charge of the examination or survey of the bars at entrance of Annapolis Harbor, with a view to ascertain the character of jetties necessary to render the proposed improvement permanent; Chester River between Kirby's and Spry's landings; water-passage between Deal's and Little Deal's islands, Md.; channel of Broad Creek, Corsica Creek, Upper thoroughfare leading into Tangier Sound, Deil's Island, and Rock Creek, Md.; survey of James River, Va., Skipton Creek and Bush River, Md.; and surveys across the peninsula of Maryland and Delaware to connect by canal the waters of the Delaware and Chesapeake bays. In charge of grounds at Yorktown, Va., for purpose of the Centennial Celebration in October, 1881, and the erection of a monument at Yorktown, Va. Member of Board of Engineers on Davis Island Dam, Ohio River. Commissioned Lieutenant Colonel, Corps of Engineers, to date from January 2, 1881.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS.	
Cyrus B. Comstock *Bvt. Brig. General.*	In charge of the survey of Northern and Northwestern Lakes. Member of the "Mississippi River Commission" created by act of Congress approved June 28, 1879. Member of Board of Engineers for consideration of plans for pier building on East Coast of Lake Michigan, designed by Major *Harwood;* of Boards of Officers of Engineers at New York City for the Examination of Officers for promotion in the Corps of Engineers; of Board of Engineers on project for the improvement of the Mississippi River in vicinity of Piasa Island, prepared and submitted by Captain *Ernst;* of Board of Engineers on harbor of refuge on Lake Superior at Grand Marais, Mich.; of Board of Engineers upon plan and location submitted by Major *Houston* for improving Milwaukee Bay for harbor of refuge.
Godfrey Weitzel *Bvt. Major General.*	In charge of the construction of harbor of refuge on Lake Huron. In charge of the Louisville and Portland Canal and of Saint Mary's Falls Canal; of the improvement of the Falls of the Ohio and Saint Mary's Falls Canal and of the rivers Saint Mary and Detroit, Mich. Member of Board of Engineers upon bridging the Ohio River; of Board of Engineers on plans for pier building on East Coast of Lake Michigan, designed by Major *Harwood;* of Board of Engineers on Davis Island Dam, Ohio River; of Board of Engineers on plan for harbor of refuge on Lake Superior at Grand Marais, Mich.; of Board of Engineers on plan and location submitted by Major *Houston* for improving Milwaukee Bay for harbor of refuge; and associate member of Board of Engineers for the Pacific Coast on construction of canal around the Cascades of Columbia River, Oreg. Engineer 11th Lighthouse District.
Orlando M. Poe *Bvt. Brig. General.*	On detached service. Aide-de-Camp on the personal staff of the General of the Army with the rank of Colonel. Member of Board to appraise the Fort Gratiot Military Reservation. Under special instructions of the General of the Army, to proceed to Texas and New Mexico. In charge of completion of sale of cemetery and other grounds on the Fort Gratiot Military Reservation. Member of Lighthouse Board.
David C. Houston *Bvt. Colonel.*	In charge of the improvement of the harbors at Milwaukee, Racine, and Kenosha, Wis., and Waukegan, Ill., and harbor of refuge at Milwaukee Bay; in charge of the improvement of the rivers Fox and Wisconsin; in charge of the examination or survey of Milwaukee Bay and for bayou south of Milwaukee harbor for additional harbor of refuge. Member of Board of Engineers on improvement of the harbor at Michigan City, Ind.; of Board of Engineers for purpose of carrying out provisions of River and Harbor act of June 14, 1880, making appropriation for harbor at Waukegan; of Board of Engineers on project for dam at outlet of Lake Winnibigoshish on the Mississippi River, proposed by Captain *Allen;* of Board of Engineers on plan for further prosecution of harbor improvement at head of Lake Superior; and associate member of Board of Engineers for the Pacific Coast on construction of canal around the Cascades of the Columbia River, Oreg.
George H. Elliot	In charge of the 1st and 2d Divisions, Office of the Chief of Engineers.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (Continued.)	
Henry M. Robert	In charge of the improvement of the harbors at Ontonagon, Eagle Harbor, Marquette, and harbor of refuge at Grand Marais, Mich., Lake Superior; Menomonee, Green Bay, Ahnepee, Two Rivers, Manitowoc, Sheboygan, Port Washington, Manistique, harbor of refuge at entrance to Sturgeon Bay Canal, Lake Michigan, and harbors at Kewaunee and Oconto, Wis., and advisory engineer for improvement of harbor at Kewaunee, Wis. In charge of the examination or survey for a harbor on Lake Michigan, at Kewaunee, Wis., of harbor at mouth of Cedar River, on Green Bay, and mouth of Cedar River, Green Bay, Mich. Member of Board of Engineers on improvement of the harbor at Michigan City, Ind.; of Board of Engineers for purpose of carrying out provisions of River and Harbor act of June 14, 1880, making appropriation for harbor at Waukegan; of Board of Engineers on project for dam at outlet of Lake Winnibigoshish on the Mississippi River, proposed by Captain *Allen*; of Board of Engineers on plan and location submitted by Major *Houston* for improving Milwaukee Bay for harbor of refuge; and of Board of Engineers on plan for a harbor of refuge on Lake Superior at Grand Marais, Mich.
William E. Merrill *Bvt. Colonel.*	In charge of the construction of ice-harbors at or near Cincinnati, and at mouth of Muskingum River, Ohio. In charge of the improvement of the rivers Ohio and Monongahela, and the Allegheny, Pa. In charge of examination or survey for ice-harbor, Bellaire, Ohio; Youghiogheny River, to begin at its mouth at McKeesport and end at Connellsville, Pa.; Ohio River at head of Hurricane Island and Elizabethtown, Ill.; Red Bank Creek, Pa., from its mouth on Allegheny River to Brookville; for the construction of two ice-breakers in Ohio River near West Virginia shore, and below the railroad bridge crossing said river at Parkersburg; ice-harbor at Point Pleasant, W. Va.; and Clarion River, Pa. Member of Board of Engineers upon bridging the Ohio River; of Board of Engineers on Davis Island Dam, Ohio River; and associate member of the Board of Engineers during the consideration of plans for the improvement of the Ohio River proposed by Mr. Herman Haupt, C. E. Engineer 14th Lighthouse District.
Walter McFarland	In charge of the construction of Fort Wayne, Mich., and forts Porter, Ontario, and Niagara, N. Y. In charge of the improvement of the harbors at Dunkirk and Buffalo on Lake Erie; Olcott, Oak Orchard, Charlotte, Pultneyville, Big Sodus, Little Sodus, Oswego, and Wilson on Lake Ontario, and Ogdensburg and Waddington on the river St. Lawrence. In charge of the improvement of Niagara River, N. Y. In charge of the examination or survey of Ogdensburg Harbor, Niagara River, at mouth of Tonawanda Creek, Port Day, above Falls of Niagara, and Grass River, at Massena, and Sackett's Harbor, N. Y. On temporary duty with the Torpedo School at Willetts Point, New York Harbor.
Orville E. Babcock *Bvt. Brig. General.*	On detached service; Engineer 5th Lighthouse District.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS (continued).	
John M. Wilson .... *Bvt. Colonel.*	In charge of the improvement of the harbors at Port Clinton, Monroe, Toledo, Sandusky, Huron, Vermillion, mouth of Black River, Rocky River, Cleveland, Fairport, Ashtabula, Conneaut, and Erie, on Lake Erie. In charge of the improvement of Sandusky River, Ohio. In charge of the examination or survey of Sandusky River near Fremont, Chagrin River, Toledo Harbor for depth of sixteen feet, Maumee River from Perrysburg to Toledo, Saint Mary's River from town of Saint Mary's to its mouth, Ohio, and harbor at Toledo, Ohio, for a straight channel to Lake Erie. Survey to ascertain the practicability and cost of construction of a ship-canal from Lake Erie by the Maumee and Wabash Valleys, in the bed of the old Wabash and Erie Canal, or with any variation therefrom that may prove feasible, to the navigable waters of Wabash River; survey and estimate of cost of a similar canal from Junction City, on the Wabash and Erie Canal, to the Ohio River, by way of the Miami and Erie Canal, or any variation in route to produce the most practical and least expensive ship-canal from Lake Erie to the navigable waters of the Ohio River by the above routes. Engineer 10th Lighthouse District.
Franklin Harwood....... *Bvt. Lieut. Colonel.*	In charge of the improvement of the harbors at Cheboygan, Au Sable, and Sebewaing, on Lake Huron, harbor on Saint Clair River, at mouth of Black River, harbor of Alpena, at Thunder Bay; harbors at Charlevoix, Frankfort, Manistee, Ludington, Pentwater, White River, Muskegon, Grand Haven, Black Lake, Saugatuck, South Haven, and Saint Joseph and water channel leading up to Benton harbor, and harbor of refuge at Portage Lake, on Lake Michigan; and removing bar at ice-harbor of refuge at Belle River, Michigan. In charge of the improvement of Saginaw, Saint Joseph, and Clinton rivers, and Grand River from its mouth to the city of Grand Rapids, Mich. In charge of the examination or survey of Grand River below Grand Rapids, Swan Creek, Empire Bay, and Clinton River and Lake Saint Clair at the mouth of Clinton River, Michigan; and harbor at Caseville, Saginaw Bay, Lake Huron. In charge of Saint Clair Flats Canal. Member of Board of Engineers on plans for pier building on East Coast of Lake Michigan, designed by Major *Harwood.*
John W. Barlow........ *Bvt. Lieut. Colonel.*	In charge of forts Griswold and Hale, and the construction of Fort Trumbull, Conn. In charge of the improvement of the harbors of Stonington, New Haven, Bridgeport, Milford, Southport, New London, and Norwalk, Conn., and Port Jefferson, N. Y.; and of the construction of breakwater at New Haven, Conn. In charge of the improvement of the rivers Housatonic and Thames, Conn. In charge of the examination or survey for opening channel between Lloyd's Harbor and Cold Spring Bay, N. Y.; harbors of Madison and Clinton, Conn.; Greenport Harbor, and harbor of Mamaroneck, N. Y.; and survey for breakwater and harbor of refuge at Milford, Conn.
Peter C. Hains .... *Bvt. Lieut. Colonel.*	On detached service; Engineer 6th Lighthouse District.
Francis U. Farquhar.... *Bvt. Lieut. Colonel.*	On detached service; Engineer Secretary to Lighthouse Board.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (continued.)	
George L. Gillespie ..... *Bvt. Lieut. Colonel.*	In charge of works of defense at the mouth of the Columbia River. In charge of the improvement of the harbor at Coos Bay, and entrance to Yaquina Bay, Oreg. In charge of the construction of the Canal around the Cascades of the Columbia River, and of the improvement of the rivers Willamette, Yamhill, Columbia, Snake, Skagit, Cowlitz, and mouth of Coquille River; and of Lower Clearwater River, Idaho. In charge of examination or survey of Columbia River at the Dalles, and the Stillaquamish, Nooksack, and Snohomish rivers, Wash.; Sinslaw Bay, Young's, Lewis' and Clarke's, and Skipannon rivers, entering into Young's Bay, Oreg.; Snake River, from Lewiston to the mouth of Salmon River, Idaho; entrance to Gray's Harbor, between Baker's Bay and Shoalwater Bay, for canal for light-draught vessels; survey of Chehallis River, Wash. Associate member of Board of Engineers for Pacific Coast while considering the improvement of harbor of refuge between the Straits of Fuca and San Francisco, Cal., and canal around the Cascades of the Columbia River, Oreg. Engineer 13th Lighthouse District.
Charles R. Suter........	In charge of the improvement of the rivers Mississippi, Missouri, and Arkansas—removal of snags, &c.; and of the Missouri River at the following localities: St. Charles, Cedar City, Glasgow, Lexington, Kansas City, Fort Leavenworth, Atchison, Saint Joseph, Brownville, Nebraska City, Eastport, Plattsmouth, Omaha, Council Bluffs, Sioux City, and Vermillion, and from Kansas City to its mouth; of Gasconade River and the Arkansas River between Fort Smith, Ark., and Wichita, Kans., and at Pine Bluff. In charge of the survey of the Missouri River from its mouth to Sioux City, Iowa, and to Fort Benton, Mont., and at Boonville, Yankton, Niobrara, and from Tuque Creek to one mile west of Charette Creek, Mo., and at Brunswick, Mo., with reference to boat-landing; mouth of Grand River; Missouri River at or near Arrow Rock, and survey of Nishnabotana from Hamburg, Iowa, to its junction with the Missouri. Member of "The Mississippi River Commission" created by Act of Congress approved June 28, 1879. Member of Board of Engineers on improvement of the Mississippi River in vicinity of Piasa Island, prepared and submitted by Captain *Ernst*. Engineer 15th Lighthouse District.
Jared A. Smith..........	In charge of the improvement of the harbors at Michigan City, Ind., and New Buffalo, Mich. In charge of the improvement of the rivers Wabash, Ind. and Ill., and White, Ind. In charge of survey for harbor of refuge at New Buffalo, Mich. Member of Board of Engineers for consideration of matters connected with improvement of the harbor at Michigan City, Ind.
Samuel M. Mansfield.... *Bvt. Lieut. Colonel.*	In charge of the improvement of the harbors at Galveston and Brazos Santiago, Tex. In charge of the improvement of ship channel in Galveston Bay, Pass Cavallo, Aransas Pass and Bay up to Rockport and Corpus Christi, Brazos River, and of the narrows above Orange on Sabine River, and deepening the channel at mouth of said river; deepening channel at mouth of Trinity River, and removal of

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (continued.)	obstructions to Liberty; deepening of channel at mouth of Neches River, and removal of obstructions to Beaumont; the protection of river bank at Fort Brown and Buffalo Bayou, Tex. In charge of the examination or survey of canal connecting Galveston and Brazos River; of Buffalo Bayou, Tex., from Simm's Bayou to the mouth of White Oak Bayou at Houston; of Matagorda Bay at the mouth of Saint Mary's Bayou, Tex.; Sabine Pass, Tex.; through Sabine Lake and River to Orange and Sabine Lake; and the Neches River to Beaumont, to ascertain the cost and practicability of a deep-water channel from Sabine Pass to Orange and Beaumont; from Brazos de Santiago through Laguna Madre to Point Isabel, Tex., to ascertain the cost and practicability of a deep-water channel from the anchorage at Brazos de Santiago to the railroad wharf at Point Isabel; re-survey of Sabine and Neches rivers, Tex.
William J. Twining	On detached service; Engineer Commissioner of the District of Columbia.
William R. King........	In charge of the improvement of the rivers Tennessee, Tenn. and Ala., Cumberland above and below Nashville, Ky. and Tenn., Hiawassee, Caney Fork, Obed's, Duck, French Broad, and Clinch, Tenn.; Oostenaula, Coosawattee, Etowah, Oconee, and Ocmulgee, Ga.; Coosa, Ga. and Ala., and Red River from its mouth to Port Royal, Tenn. In charge of the examination or survey of Clinch River, in counties of Hancock, Hawkins, and Claiborne, Tenn., and Scott and Russell, Va.; Powell River, in counties of Hancock and Claiborne, Tenn., and Lee, Va.; Holston River, in counties of Sullivan, Hawkins, Grainger, and Hamblen, Tenn., and Washington and Scott, Va.; headwaters of the Savannah River, in connection with the headwaters of Hiawassee and Tennessee rivers, with view of ascertaining if a summit level can be secured to unite them by a canal; South Fork of Cumberland River, Ky.; Red River from Port Royal, Montgomery County, Tenn., to its mouth; of Bear Creek, running from Northeast Mississippi into the Tennessee River, Little Tennessee River from its mouth on the Holston or Big Tennessee River to the mouth of Tellico River, and Cumberland River at Smith's Shoals, Ky., to ascertain the practicability and cost of a canal, with locks and dams, from the head to the foot of said shoals; of Chattahooche River, Ga., between West Point and Bolton.
Wm. H. H. Benyaurd...	In charge of the improvement of the harbors at Memphis, Tenn., and Vicksburg, Miss. In charge of the improvement of the rivers Saint Francis, White, L'Anguille, Fourche Le Fève, Saline, and Black, Ark., the Ouachita in La. and Ark., Yazoo in Miss., and Cypress Bayou, La. and Tex.; of mouth of the Red River, La., Upper Rod River from Fulton to head of Raft; of the rivers Big Sun Flower, Coldwater, and Tallahatchie, Miss., and the Mississippi River at Memphis, Natchez, Vidalia, and Vicksburg, and the Big Hatchie River, Tenn.; of removal of raft, snags, and other obstructions from Red River, and of closing Tones' Bayou; of Tensas River; Bayou Bœuf, La., and Bayou Bartholomew, La. and Ark.; Yallabusha River and Tchula Lake, Miss. In charge of the water-gauges on the Mississippi River and its principal tributaries. In

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (continued).	charge of the examination or survey of bayous Bartholomew and Macon, and Tensas River, La.; Saint Francis River from Greenville, and from Greenville, Mo., to the Cairo, Arkansas and Texas Railroad; Currant River from Van Buren, Mo., to its mouth in Ark.; harbor at Grand Gulf, Miss.; Obion, South Forked Deer, and North Forked Deer rivers, Tenn.; Cache River a tributary of White River, and The Bay a tributary of Saint Francis River, Ark.; Bœuf River, North Louisiana.
Charles W. Howell......	In charge of the construction of forts Jackson, Saint Philip, Livingston, Pike, and Macomb, Tower Dupré, Battery Bienvenue, and Tower at Proctorsville. In charge of the improvement of the harbor at New Orleans, La. In charge of the improvement of the Amite, Vermillion, and Tangipahoa rivers, bayous Terrebonne, Teche, and Courtableau, La.; of Sabine Pass and Blue Buck Bar, Tex., and of Pearl River, Miss.; removal of obstructions in Bayou La Fourche, La.; of Calcasieu Pass and Calcasieu River, from Phillips Bluff to its mouth; Bayou Black, and Tickfaw and Tchefuncte rivers. In charge of the surveys for a breakwater near New Orleans, La., survey of Lake Pontchartrain, La., and the examination or survey of Calcasieu River, bayous Plaquemine, Black, Grand Caillou, Little Caillou, Andre, Fusilier, Grand Lake, Little Lake, and Barataria Bay from New Orleans to Grand Pass, Atchafalaya River from Berwick's Bay to mouth of Red River, Bogue Chitto River from its mouth to Franklinton, and Bogue Falia from its mouth to 25 miles above Covington, La.; West Pearl River; Pass Manchac and Bayou Manchac, La., from its mouth to the Mississippi River. Member of Board on improvement of Pass Cavallo Inlet, Aransas Pass and Bay, and entrance to Galveston Harbor, Tex.
Garret J. Lydecker.....	In charge of construction of the harbors at Chicago and Calumet, Ill. In charge of the improvement of the Illinois River. In charge of the examination or survey of the Chicago River from its mouth to junction of the North and South branches: that part of the North Branch of the Chicago River lying in the town of Lake View, and Calumet River from South Chicago to the village of Pullman, on Lake Calumet. Member of Board of Engineers for consideration of matters connected with improvement of the harbor of Michigan City, Ind.; of Board of Engineers for purpose of carrying out provisions of river and harbor act of June 14, 1880, making appropriation for harbor at Waukegan; of Board of Engineers, on project for dam at outlet of Lake Winnibigoshish on the Mississippi River, proposed by Captain *Allen*.
Amos Stickney	In charge of the improvement of the Des Moines Rapids of the Mississippi River. In charge of operating the Des Moines Rapids Canal. In temporary charge of the improvement of the harbors at Michigan City, Ind., and New Buffalo, Mich. In temporary charge of the improvement of the rivers Wabash, Ind. and Ill., and White, Ind. Commissioned Major, Corps of Engineers, to date January 2, 1881.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS.	
James W. Cuyler	In charge of the improvement of the Little Kanawha and Guyandotte rivers, W. Va., the Big Sandy River, W. Va. and Ky., and the Kentucky River and Tradewater River, Ky. In charge of the examination or survey of Tradewater River, and Licking River from its mouth to Falmouth, Ky.
Alexander Mackenzie ...	In charge of the improvement of the harbors at Fort Madison, Burlington, and Muscatine, Iowa, Rock Island and Galena, Ill. In charge of the improvement of the Mississippi River, from St. Paul to Des Moines Rapids; from Des Moines Rapids to the mouth of the Illinois River at Quincy, Quincy Bay, Ill., Hannibal and Alexandria, Mo., and at or near La Crosse, Wis.; of Rush Chute, Iowa, and the Upper Mississippi River and Rock Island Rapids of the Mississippi River, and Galena and Cuivre rivers, removing bars in Mississippi River opposite Dubuque and Guttenberg, Iowa, and protection of Rock Island Bridge by shear-booms; of the Mississippi River at Andalusia, Ill., and at Louisiana, Mo. In charge of the examination or survey of Mississippi River at Andalusia, Ill., and Louisiana, Mo., and of the survey for a harbor of refuge in Lake Pepin, at Stockholm, Wis., and Lake City, Minn. Member of Board of Engineers on project for the improvement of the Mississippi River in vicinity of Piasa Island, prepared and submitted by Captain *Ernst;* and of Board of Engineers on plan for further prosecution of harbor improvement at head of Lake Superior.
Oswald H. Ernst	In charge of the improvement of Mississippi River between the mouths of the Illinois and Ohio rivers, and at Cape Girardeau and Minton's Point, Mo., and of Osage River in Missouri and Kansas. In charge of construction of ice-harbor at St. Louis, Mo., and of improvement of harbor and Mississippi River at Alton. In charge of the examination or survey of Mississippi River at Saint Genevieve and Maramec River from the mouth to the point opposite Maramec Iron Works, Mo., and of Fish Bend, near Fort Chartres, in the Mississippi River.
David P. Heap	On detached service; Engineer 10th Lighthouse District. Military Delegate of the United States to Congress of Electricians, and Honorary Commissioner of the United States to the Paris Electrical Exhibition of 1881.
William Ludlow........ *Bvt. Lieut. Colonel.*	On duty under the immediate orders of Colonel *Macomb.* Secretary to the commission advisory to Board of Harbor Commissioners of Philadelphia.
Charles B. Phillips	In charge of the improvement of the harbors at Norfolk, Va., and Edenton and Beaufort, N. C. In charge of the improvement of the Blackwater and Nottaway rivers and Pagan Creek, Va., Neuse, Scuppernong, Pamplico, Yadin, Trent, and Tar rivers, Currituck Sound, Coanjok Bay, North River Bar, N. C., and North Landing River, Va. and N. C.; Waccamaw and Great Pee Dee rivers, S. C.; of Archer's Hope River, Va.; Contentnia Creek, Lillington River, Cape Fear River from Wilmington to Fayetteville, and Town Creek, N. C.; and Wateree and Santee rivers, S. C. In charge of the examination or survey of Pocossin and Lillington rivers, Beaufort Harbor, Town

***Statement showing rank and duties of officers of Corps of Engineers*—Cont'd.**

RANK AND NAME.	DUTIES.
CAPTAINS. (continued).	Creek, and Cape Fear River above Wilmington, N. C.; Georgetown Harbor, Lynch, Wateree, and Black rivers, S. C.; of bar at mouth of Winyah Bay, S. C.; water connection between the Waccamaw and Cape Fear rivers, with the view of ascertaining if a continuous inland water connection cannot thereby be established; Oregon Inlet, Whiteoak, Meherrin, and New rivers, N. C. Advisory Engineer to National Board of Health in the establishment of a National Quarantine Station in Hampton Roads, Va. Died at Norfolk, Va., June 14, 1881.
William A. Jones	On detached service; Engineer Officer, Military Division of the Pacific and Department of California.
Andrew N. Damrell ..... *Bvt. Major.*	In charge of the construction of defenses of Mobile and Pensacola, and of fort on Ship Island, Miss. In charge of the improvement of the harbors at Pensacola and Cedar Keys, Fla., and Mobile, Ala. In charge of the improvement of the rivers Chattahooche, Appalachicola, and Suwannee, Fla., Flint, Ga., Alabama, Ala., Pascagoula, Noxubee, Miss., Warrior and Tombigbee, in Ala. and Miss., and Escambia River, Fla. and Ala.; Appalachicola and Tampa bays, and removal of obstructions in the Choctawhatchee River, Ala. and Fla., and Pease Creek and Withlacoochee River, Fla. In charge of the examination and survey of the rivers Warrior, Sipsey, Cahaba, Tallapoosa, and Coosa, Ala.; Finhollaway, Chipola, Ocolockonnee, and Blackwater rivers, East Bay, Holmes Creek, Aucilla and Wacissa, Fla., and of Tombigbee River, Miss., from Fulton to Warren's Mill; Dog Island Harbor, harbor of Key West, Crystal River, La Grange Bayou up to Freeport, Manatee River, and Crooked River, Fla.; outlet of harbor of Ship Island, and Biloxi and Pascagoula harbors, and Old Town Creek, Miss.
Charles J. Allen .... *Bvt. Major.*	In charge of the improvement of the harbors at Duluth and Grand Marais, Minn. In charge of the improvement of the rivers St. Croix, Chippewa, and Minnesota, of the Red River of the North, and entrance to Superior Bay; of the Falls of St. Anthony, and of the Mississippi River above the Falls of St. Anthony. In charge of the construction of Meeker's Island lock and dam, of lock and dam at Goose Rapids, in Red River of the North, Minn. and Dak.; of dam at Lake Winnibigoshish for reservoirs at headwaters of the Mississippi River, and protection of sand banks on the Chippewa River, Wis. In charge of the examination of the sources of the rivers Mississippi, St. Croix, Chippewa, and Wisconsin, with the view of ascertaining the practicability and cost of creating and maintaining reservoirs, &c., and of headwaters of Rock River in Wis. and Ill. In charge of the examination or survey of Snake River, Minn.; Upper Red River of the North, between Fargo, Dak., and Breckinridge, Minn.; Mississippi River at Sauk Rapids near Saint Cloud, Minn.; Minnesota River near Belle Plain, with a view to protect the narrow neck of land opposite said village and prevent injury to navigation of river, in Minnesota; of Beaver Bay, Grand Portage Bay, and Wans-wau-goising Bay, and headwaters of the Cannon River, Minn. Member of Board of Engineers on dam at outlet of Lake Winnibigoshish on the Mississippi River, proposed by Captain *Allen;* of Board of Engineers on plan for further prosecution of harbor improvement at head of Lake Superior.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	
Charles W. Raymond ...	On detached service; on duty at the Military Academy as instructor of Practical Military Engineering, Military Signaling, and Telegraphy, and in command of Company E, Battalion of Engineers. In charge of construction of water-works and of new cadets' hospital, and extension of cadet barracks at West Point, N. Y.
L. Cooper Overman.....	On duty under the immediate orders of Major *King*.
Alexander M. Miller	Commanding Company B, Battalion of Engineers.
Milton B. Adams........	On duty under the immediate orders of Major *Wilson*.
Wm. R. Livermore......	On detached service; Engineer Officer, Department of Texas.
William H. Heuer	In charge of the construction of forts Jefferson and Taylor, Fla. To report upon the depth and width of a channel secured and maintained by jetties constructed by James B. Eads at the mouth of the Mississippi River. Consulting Engineer for the establishment by the National Board of Health of a National Quarantine Station at Ship Island, Miss. Engineer 7th and 8th Lighthouse districts.
William S. Stanton	On detached service; Engineer Officer, Department of the Platte. Member of Board of Officers at Fort Omaha, Nebr., April 20, to examine into qualifications for promotion to grade of Second Lieutenant in the Army of such non-commissioned officers as may be ordered before it for examination.
Thomas H. Handbury ..	On duty under the immediate orders of Major *Suter*. In charge of the improvement of the Arkansas River—removal of snags, &c., Arkansas River between Fort Smith, Ark., and Wichita, Kans., and at Pine Bluff, and of rivers St. Francis, White, L'Anguille, Fourche Le Fève, Saline, and Black, Ark., and Current, Mo. and Ark. In charge of the examination or survey of Little Red River, Ark.
James C. Post	On duty under the immediate orders of Lieutenant-Colonel *Gillmore*. Consulting Engineer in the establishment of a National Quarantine Station at Blackbeards Island, Ga., under direction of the National Board of Health, and of the work to be done by its authority in connection with the Quarantine Station established by the City of Charleston, S. C. To examine and report to the National Board of Health upon certain questions concerning the manner in which the Water Company of Charleston are laying their water-pipes.
James F. Gregory	On detached service. Engineer Officer, Military Division of the Missouri.
Henry M. Adams	In charge of the 4th and 5th divisions, Office of the Chief of Engineers.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	
James Mercur	On duty under the immediate orders of Colonel *Newton*. Recorder of Board of Engineers on improvement of Charleston Harbor, S. C. In charge of the improvement of the harbors at Norfolk, Va., Beaufort and Edenton, N. C. In charge of the improvement of the Blackwater, Nottaway, and Archer's Hope rivers, and Pagan Creek, Va., Neuse, Scuppernong, Pamplico, Yadkin, Trent, Tar, Lillington, and Cape Fear rivers, Currituck Sound, Coanjok Bay, North River Bar, Contentnia and Town creeks, N. C., and North Landing River, Va. and N. C.; Waccamaw, Great Pee Dee, Wateree, and Santee rivers, S. C. In charge of the examination or survey of bar at mouth of Winyah Bay, near Georgetown, S. C.; the water connection between Waccamaw and Cape Fear rivers, Oregon Inlet, and Whiteoak, Meherrin, and New rivers, N. C. Advisory Engineer to National Board of Health in the establishment of a National Quarantine Station in Hampton Roads, Va.
Chas. E. L. B. Davis	On duty under the immediate orders of Major *Mansfield*. In charge of the improvement of Sabine Pass and Blue Buck Bar, and Sabine River, La. and Tex., and Neches River, Tex. In charge of surveys through Sabine Lake and River to Orange and through Sabine Lake and Neches River to Beaumont.
Benjamin D. Greene	On temporary duty under the immediate orders of Major *Weitzel*. On duty under the immediate orders of Lieutenant-Colonel *Gillmore*.
George M. Wheeler	In charge of Geographical Surveys of the territory west of the 100th meridian. On detached service in connection with the International Exhibition of Geography at Venice, Italy.
James B. Quinn	Commanding Company A, Battalion of Engineers. Member of General Court Martial at Willets Point, New York Harbor, December 2, 1880. On detached service; in charge, and disbursing officer, of works on the Mississippi River under supervision of "The Mississippi River Commission" created by act of Congress approved June 28, 1879.
Daniel W. Lockwood	On duty under the immediate orders of Major *Howell*.
Ernest H. Ruffner	On detached service; Engineer Officer, Department of the Missouri. In local charge of the improvement of the Great Kanawha River under the immediate orders of Lieutenant-Colonel *Craighill*.
John C. Mallery	Commanding Company C, Battalion of Engineers. Member of General Court Martial at Willets Point, New York Harbor, December 2, 1880.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

NAME AND RANK.	DUTIES.
CAPTAINS. (continued.)	
Clinton B. Sears	On detached service; on duty at the Military Academy as Assistant Professor of Natural and Experimental Philosophy. In charge of plans and specifications for new Astronomical Observatory at West Point, N. Y. Assisting the prosecution in the case of the United States *in re* Whittaker.
Thomas Turtle	On duty under the immediate orders of Lieut. Col. *Craighill.* Member Board of Engineers on Davis Island Dam, Ohio River. Commissioned Captain, Corps of Engineers, to date January 2, 1881.
Edward Maguire	In charge of the improvement of the Yellowstone River, and of the Missouri River above the mouth of the Yellowstone. In charge of the survey of the Yellowstone River and examination or survey of Cheyenne River, Dak. Engineer Officer, Department of Dakota. Promoted to Captain, Corps of Engineers, to date June 14, 1881.
Frederick A. Mahan	On duty under the immediate orders of Major *Merrill.* Member of Board of Engineers on Davis Island Dam, Ohio River. Promoted Captain, Corps of Engineers, to date June 17, 1881.
Charles F. Powell	On duty under the immediate orders of Major *Gillespie.* Promoted Captain, Corps of Engineers, to date June 17, 1881.
Frederick A. Hinman	On duty under the immediate orders of Major *Houston.* Promoted Captain, Corps of Engineers, to date June 17, 1881.
FIRST LIEUTENANTS.	
Albert H. Payson	On duty under the immediate orders of Lieutenant-Colonel *Stewart,* and of the Board of Engineers for the Pacific Coast. On temporary duty under Major *Gillespie.*
John G. D. Knight	On detached service; on duty at the Military Academy as Assistant Professor of Mathematics. Member of General Court Martial at West Point, N. Y., May 24, 1881.
Richard L. Hoxie	On detached service; Assistant to the Engineer Commissioner of the District of Columbia.
William L. Marshall	On duty under the immediate orders of Major *King.* On detached service; in charge, and disbursing officer, of works on the Mississippi River under supervision of "The Mississippi River Commission" created by act of Congress approved June 28, 1879.
Joseph H. Willard	On duty under the immediate orders of Colonel *Newton.* Recorder to Board appointed by the President to co-operate with the authorities of the State of New York in examining and deciding upon exterior pier and bulkhead lines on Hudson River from State dam at Troy to the city

***Statement showing rank and duties of officers of Corps of Engineers*—Cont'd.**

NAME AND RANK.	DUTIES.
FIRST LIEUTENANTS. (continued.)	of Hudson. Recorder of Board to determine under a law of the State of New York the pier and bulkhead lines of New York Harbor along the Staten Island shore. Adjutant and Treasurer of the Battalion of Engineers and Post of Willets Point and Signal Officer Post of Willets Point. Commanding Company D, Battalion of Engineers. Temporarily A. A. Q. M., A. C. S., and Recruiting Officer, Post of Willets Point.
Eric Bergland	On detached service; on duty at the Military Academy as Acting Assistant Professor of Mathematics. Assistant Professor of Ethics and Law.
Samuel E. Tillman......	On detached service; on duty at the Military Academy as Assistant Professor of Chemistry, Mineralogy, and Geology. Resigned, to date December 31, 1880.
Philip M. Price	On duty under the immediate orders of Major *Comstock*. On temporary duty under the orders of the Commanding General Department of Texas. On duty under the immediate orders of Major *Gillespie*.
Francis V. Greene	On detached service; Assistant to the Engineer Commissioner of the District of Columbia.
Carl F. Palfrey	On detached service; Engineer Officer, Department of Arizona. Detailed to assist Special Indian Agent E. B. Townsend in establishing and perfecting system of irrigation at the Pima and Maricopa Indian Agency, Ariz. To make reconnaissance and survey of reservation occupied by the Yavai-Supai Indians.
William H. Bixby	Absent in Europe for the purpose of attending the École des Ponts et Chaussées at Paris. Elève externe à l'École des ponts et Chaussées. Designated to witness the maneuvers to take place, this autumn, within the several commands of the French Army.
Henry S. Taber..........	On detached service; on duty at the Military Academy as Assistant Instructor of Practical Military Engineering, and with Company E, Battalion of Engineers. Recruiting officer for the Battalion of Engineers at West Point. Assistant Engineer on water-supply and Assistant Director of Post School at West Point, N. Y.
William T. Rossell......	On detached service; on duty at the Military Academy as Assistant Professor of Civil and Military Engineeing. On duty under the immediate orders of Colonel *Thom*.
Thomas N. Bailey.......	On detached service; on duty at the Military Academy as Acting Assistant Professor of Mathematics. Engineer Officer District of New Mexico. Engineer Officer Department of the Missouri. Member General Court Martial at Santa Fé, N. M., February 10, 1881.
Thomas W. Symons.....	On detached service; Engineer Officer and Chief Signal Officer Department of the Columbia. In charge of improvement and repair of military wagon road from Scottsburg to Camp Stewart, Oreg. Survey and location of a wagon road from Camp Chelan, Wash., to some point on the line of the Northern Pacific Railroad. Engaged in

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

NAME AND RANK.	DUTIES.
FIRST LIEUTENANTS. (continued.)	selecting site for new military post near Big Bend of the Columbia. Determination of latitude and telegraphic longitude of Spokane Falls and Colfax, Wash., and Lewiston, Idaho. Member of General Court Martial at Fort Lapwai, Idaho, September 6, 1880. Member of Boards of Survey at Headquarters Department of the Columbia, January 5 and 13; of Board to examine country in the vicinity of Fort Lapwai, Idaho, with view to selection of site contemplated for the construction of new post to take the place of Fort Lapwai and Camp Howard; and of Board of Officers at Vancouver Barracks, Wash., May 11, to examine and report upon qualifications of non-commissioned officers for appointment of Second Lieutenant.
Smith S. Leach	On detached service; Secretary and disbursing officer of "The Mississippi River Commission" created by act of Congress approved June 28, 1879.
Dan C. Kingman	On detached service; on duty at the Military Academy as Assistant Professor of Civil and Military Engineering.
Eugene Griffin	Q. M. Battalion of Engineers, A. A. Q. M., A. C. S., and Recruiting Officer, Post of Willets Point. Adjutant and Treasurer of the Battalion of Engineers and Post of Willets Point and Signal Officer Post of Willets Point. Commanding Company D, Battalion of Engineers. On temporary duty under the immediate orders of the Commanding General Division of the Atlantic. Member of General Court Martial at Willets Point, N. Y., December 2, 1880.
Willard Young	On detached service. On duty at the Military Academy as Acting Assistant Professor of Civil and Military Engineering. On temporary duty in office of Geographical Surveys of the territory west of the 100th meridian.
William M. Black	On duty under immediate orders of Lieutenant-Colonel *Craighill*. In local charge of Davis Island Dam, under the immediate orders of Major *Merrill*.
Walter L. Fisk	Adjutant and Treasurer of the Battalion of Engineers and Post of Willets Point, and Signal Officer Post of Willetts Point. Commanding Company D, Battalion of Engineers. On duty under the immediate orders of Lieutenant-Colone *Gillmore*.
Solomon W. Roessler	On duty with Company A, Battalion of Engineers. On temporary duty under immediate orders of Colonel *Tower*. On duty at the Military Academy as Assistant Professor of Civil and Military Engineering. Commissioned First Lieutenant, Corps of Engineers, to date December 31, 1880.
George McC. Derby	On duty with Company B, Battalion of Engineers. On temporary duty, under the immediate orders of Colonel *Newton*. Commissioned First Lieutenant, Corps of Engineers, to date January 2, 1881.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

NAME AND RANK.	DUTIES.
FIRST LIEUTENANTS. (continued.)	
James L. Lusk	On duty with Company C, Battalion of Engineers. On detached service. On duty at the Military Academy in Departments of Mathematics and Tactics. Promoted First Lieutenant, Corps of Engineers, to date June 14, 1881.
Frederic V. Abbot	On duty with Company A, Battalion of Engineers. Member of General Court Martial at Willets Point, New York Harbor, December 2, 1880. In command of Company A, Battalion of Engineers. Promoted First Lieutenant, Corps of Engineers, to date June 17, 1881.
Thomas L. Casey	On duty with Company B, Battalion of Engineers. Judge-Advocate of General Court Martial at Willets Point, New York Harbor, December 2, 1880. Promoted First Lieutenant, Corps of Engineers, to date June 17, 1881.
Theodore A. Bingham	On duty with Company C, Battalion of Engineers. Member of General Court Martial at Willets Point, New York Harbor, December 2, 1880. Promoted First Lieutenant. Corps of Engineers, to date June 17, 1881.
SECOND LIEUTENANTS.	
Curtis McD. Townsend	On duty with Company A, Battalion of Engineers. Member of General Court Martial at Willets Point, New York Harbor, December 2, 1880.
Gustav J. Fiebeger	On duty with Company B, Battalion of Engineers. Member of General Court Martial at Willets Point, New York Harbor, December 2, 1880.
Oberlin M. Carter	On special duty at the Military Academy, West Point, N. Y. On duty with Company C, Battalion of Engineers.
George W. Goethals	On special duty at the Military Academy, West Point, N. Y. On duty with Company A, Battalion of Engineers.
John Millis	Apppointed Second Lieutenant, Corps of Engineers, to date from June 11, 1881.
John Biddle	Appointed Second Lieutenant, Corps of Engineers, to date from June 11, 1881.
Edward O. Brown	Attached as Additional Second Lieutenant, Corps of Engineers, to date from June 11, 1881. Promoted Second Lieutenant, Corps of Engineers, to date June 14, 1881.
ADDITIONAL SECOND LIEUTENANTS.	
Harry F. Hodges	Attached as Additional Second Lieutenant, Corps of Engineers, to date from June 11, 1881.
James G. Warren	Attached as Additional Second Lieutenant, Corps of Engineers, to date from June 11, 1881.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

NAME AND RANK.	DUTIES.
OFFICERS OF THE ARMY DETAILED FOR SERVICE UNDER THE CHIEF OF ENGINEERS.	
A. F. Rockwell *Colonel, U. S. A.*	In charge, under the Chief of Engineers, of Public Buildings and Grounds in the District of Columbia, with the rank of Colonel.
M. M. Macomb *Lieut. 4th U. S. Artillery.*	In charge of Geographical Surveys of the territory west of the 100th meridan.
UNITED STATES CIVIL ENGINEERS.	
S. T. Abert	In charge of the improvement of the harbors at Washington and Georgetown, D. C., harbor at Breton Bay, Leonardtown, Md., and harbor at entrance to Saint Jerome's Creek, Md. In charge of the improvement of the rivers Occoquan, Rappahannock, Hampton, Chickahominy, Mattaponi, Totusky, York, Pamunky, and Staunton, Va., Roanoke and French Broad, N. C., and Dan River, Va. and N. C.; of channel in Potomac River through flats in front of landing at Mount Vernon; of Aquia, Nomini, Urbana, and Neabsco creeks, Va. In charge of the examination or survey of Neabsco Creek, Potomac River at mouth of Pohick Creek, mouth of Currioman Bay, Va.; Nomini River from the ferry to head of tide-water, Staunton River, Va., Roanoke River, N. C. and Va., Potomac and Anacostia rivers, D. C.; survey of Upper Machodoc and Urbana Creeks.
M. Meigs	On duty under immediate orders of Captain *Mackenzie*.

LAWS

AFFECTING

THE CORPS OF ENGINEERS,

UNITED STATES ARMY.

FORTY-SIXTH CONGRESS, THIRD SESSION.

1880-'81.

LAWS

AFFECTING

THE CORPS OF ENGINEERS, UNITED STATES ARMY.

FORTY-SIXTH CONGRESS, THIRD SESSION, 1880-'81.

CHAP. 10.—An act to authorize the construction of a fixed bridge over the Saint Mary's River and for other purposes.

Dec. 23, 1880.

Bridge over Saint Mary's River.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Waycross and Florida Railway Company and the East Florida Railroad Company be, and they are hereby, authorized to construct a fixed bridge with one span over the Saint Mary's River at the point selected by said companies for crossing said river with their railroad line, about one and one-half miles below Trader's Hill, in Charlton County, Georgia, and to make such bridge of such height as they may see fit: *Provided*, The height be sufficient to permit the passage of timber rafts under said bridge; and such proposed railroad crossing and bridge are hereby declared to be the head of navigation on the said Saint Mary's River.

Proviso.

SEC. 2. That Congress reserves the right to alter or amend or repeal this act at any time and that if at any time the navigation of the said river shall in any way be obstructed or impaired by the said bridge the Secretary of War shall have authority and it shall be his duty to require the said companies to alter and change the said bridge at their own expense in such a manner as may be proper to secure free and complete navigation without impediment, and if upon reasonable notice to said railroad companies to make such change or improvements they shall fail to do so the Secretary of War shall have authority to make the same and all the rights conferred by this act shall be forfeited, and Congress shall have power to do any and all things necessary to secure the free navigation of the river.

Approved, December 23, 1880.

CHAP. 20.—An act for the relief of the legal representative of Henry M. Shreve, deceased.

Jan. 13, 1881.

Henry M. Shreve, deceased, payment to legal representatives of.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Treasury pay to the legal representatives of Henry M. Shreve, deceased, the sum of fifty thousand dollars as a full compensation for, and in satisfaction of, all claims for the invention of the steam snag boat, and for the use of the same, past, present, and future, and for any and all rights that the said Shreve may have acquired under the patent granted to him for the invention of the steam snag-boat.

Approved, January 13, 1881.

CHAP. 25.—An act to regulate the award of and compensation for public advertising in the District of Columbia.

Jan. 21, 1881.

Public advertising in District of Columbia—

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That all advertising required by existing laws to be done in the District of Columbia by any of the de-

award and compensation regulated.
R. S. 3828.
Proviso.

partments of the government shall be given to one daily and one weekly newspaper of each of the two principal political parties, and to one daily and weekly neutral newspaper: *Provided*, That the rates of compensation for such service shall in no case exceed the regular commercial rate of the newspapers selected; nor shall any advertisement be paid for unless published in accordance with section thirty-eight hundred and twenty-eight of the Revised Statutes.

SEC. 2. All laws or parts of laws inconsistent herewith are hereby repealed.

Approved, January 21, 1881.

Jan. 15, 1881.

CHAP. 32.—An act authorizing the persons therein named to accept of certain decorations and presents therein named, from foreign governments, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled:

* * * * * * *

Lieut'nt Francis V. Greene.

That Lieutenant Francis V. Greene, of the United States Army, be, and he is hereby, authorized to accept from the Emperor of Russia a decoration of the third class of the order of Saint Anne for bravery under fire at the battle of Shipka Pass August twenty-third and twenty-fourth, eighteen hundred and seventy-seven, and at the assault of Plevna September eleventh, eighteen hundred and seventy-seven; also, a decoration of the fourth class of the order of Saint Vladimir for bravery under fire during the passage of the Balkans December twenty-fifth to thirty-first, eighteen hundred and seventy-seven, and at the battle of Philippopolis January fifteen to seventeenth, eighteen hundred and seventy-eight; also, the campaign medal conferred upon all persons present in the campaign;

* * * * * * *

Conditions of acceptance.

SEC. 2. That no decoration, or other thing, the acceptance of which is authorized by this act, and no decoration heretofore accepted, or which may hereafter be accepted, by consent of Congress, by any officer of the United States, from any foreign government, shall be publicly shown or exposed upon the person of the officer so receiving the same.

Presents, hereafter made, tendered through Department of State and permission for acceptance and delivery obtained from Congress.

SEC. 3. That hereafter any present, decoration, or other thing, which shall be conferred or presented by any foreign government to any officer of the United States, civil, naval, or military, shall be tendered through the Department of State, and not to the individual in person, but such present, decoration, or other thing shall not be delivered by the Department of State unless so authorized by act of Congress.

Approved, January 31, 1881.

Feb. 23, 1881.

CHAP. 69.—An act to authorize the construction of a bridge across the Potomac River at or near Georgetown in the District of Columbia, and for other purposes.

Free bridge across Potomac River.
Appropriation.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he is hereby, authorized and directed to cause to be constructed across the Potomac River at or near Georgetown in the District of Columbia, at such point as he may select, a substantial iron and masonry bridge, with approaches; and the sum of one hundred and forty thousand dollars be, and the same is hereby, appropriated, out of any money in the Treasury not otherwise appropriated, for the constructon of said bridge and approaches, the same to be maintained as a free bridge for travel: *Provided*, That the said Secretary of War shall construct a bridge upon such plan as shall cost no more than the amount herein appropriated, and which cost shall include the construction of a substantial bridge over the canal, and any and all approaches to the said iron bridge; and no part of this appropriation shall be paid out of the Treasury until contracts shall have been entered into with responsible parties, and with good and sufficient sureties to be approved by the Secretary of War, for the construction and completion of said bridge, including the masonry, iron-work, and approaches, at a cost not to exceed one hundred and forty thousand dollars: *And provided also*, That a draw of sufficient width to permit the free passage of vessels navigating that part of the Potomac River shall be constructed in said bridge, unless said bridge shall be constructed upon or by the side of, or up the river from, the present aqueduct and at the same or greater elevation above the water:

Proviso.
Contracts.
Cost.
Proviso.
Draw.

Proviso.
1878, ch. 180, Stat., 20, 102.
Proviso.
Location, etc.
Advertisement.

And Provided also, That the sum which may be expended under this act shall be treated and regarded as a part of the general expenses of the District of Columbia, and the United States shall be credited with the amount which it may pay under this act for the erection of said bridge upon its fifty per centum of the expenses of the District of Columbia, as provided in the act of June eleventh, eighteen hundred and seventy-eight, entitled "An act providing a permanent form of government for the District of Columbia": *Provided further*, That the Secretary of War shall, as soon as may be, fix and determine the location of said bridge, and cause a survey of the river to be made at such place of location, determine the length, width, and height of said bridge, and the length of draw, if one is required, and thereupon advertise for plans and price for the construction of such bridge; such advertisement to be inserted in one or more daily newspapers published in Washington, District of Columbia, New York, Cleveland, Ohio, Detroit, Michigan, Philadelphia, Pennsylvania, and Chicago, Illinois, for the space of one week.

Purchase of aqueduct bridge.
Proviso.
Proviso.
Title.
Proviso.
Alexandria Canal Company, rights of.
Proviso.

SEC. 2. That for the purpose of establishing a free bridge, and in lieu of erecting the bridge provided for in the preceding section, the Secretary of War may, in his discretion, purchase the aqueduct bridge now crossing the Potomac River at Georgetown: *Provided*, said bridge with all the appurtenances, rights and franchises connected therewith including piers and real estate for abutments and approaches can be purchased for a sum not exceeding eighty-five thousand dollars; which sum or so much thereof as may be necessary may be paid out of the money appropriated by this act: *Provided further*, That a good and sufficient title thereto can be secured to the United States, to be approved by the Attorney-General of the United States. *It is further provided* That the Alexandria Canal Company or its present lessees shall have the right to maintain at their own cost and expense, a canal aqueduct of the same width and depth as the one now in use, and to attach it to or suspend it from said bridge; and whenever a permanent bridge shall be erected upon said site, the same shall be of sufficient strength to sustain the weight of such canal aqueduct; but the construction attachment and maintenance of such aqueduct shall be such as the Secretary of War may determine and shall be without cost or liability to the United States or the District of Columbia. *And it is further provided*, That if upon the erection of such permanent bridge the said canal company or their present lessees shall neglect or refuse to reconstruct secure and attach the said aqueduct at their own expense, or if at any time for the space of six months, they shall fail to use such aqueduct for the purposes of a canal, or fail to keep the same in good condition and repair, or if at any time, they shall use the same for other than canal purposes, then all rights of said canal company, its lessees or assigns in said bridge and property, shall cease and determine, and the said aqueduct shall be detached and removed by the Secretary of War.

Repairs.

SEC. 3. And the Secretary of War is further authorized, in his discretion, in the event of said purchase, to repair the wooden bridge now on said piers, and for that purpose is authorized to expend, of the moneys hereinbefore appropriated, a sum not exceeding ten thousand dollars.

Approved, February 23, 1881.

Feb. 24, 1881.

CHAP. 79.—An act making appropriations for the support of the Army for the fiscal year ending June thirtieth, eighteen hundred and eighty-two, and for other purposes.

Appropriations.
Support of the Army.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, out of any money in the Treasury not otherwise appropriated, for the support of the Army for the year ending June thirtieth, eighteen hundred and eighty-two, as follows:

* * * * * * * *

Engineer depot, Willets Point.

ENGINEER DEPARTMENT.—For engineer depot at Willets Point, New York, namely: For purchase of engineering materials to continue the present course of instruction of the Engineer Battalion in field engineering, one thousand dollars.

For incidental expenses of the depot, remodeling ponton-trains, repairing instruments, purchasing fuel, forage, stationery, chemicals, extra-duty pay to soldiers engaged in special skilled labor, such as wheelwright work, printing, photographing and lithographing engineer documents, and ordinary repairs, four thousand dollars.

* * * * * * *

Disbursement of appropriations accounted for by items as expressed.

SEC. 2. All officers, agents, or other persons receiving public moneys appropriated by this act shall account for the disbursement thereof according to the several and distinct items of appropriation herein expressed.

Approved, February 24, 1881.

March 2, 1881.

CHAP. 109.—An act to provide for the sale of certain property owned by the United States in the District of Columbia.

Land of United States in District of Columbia authorized to be sold.

Terms of sale.

Proviso.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Chief of Engineers, United States Army, in charge of public buildings and grounds in the District of Columbia, be, and is hereby, authorized to sell and convey, by good and sufficient deed, to each of the owners of lot one, square one hundred and eighty-four; lot five, square one hundred and eighty-five; lots five, six, and seven, square one hundred and ninety-eight; lot twelve, square one hundred and ninety-nine, in the city of Washington, District of Columbia, such portion of the ground immediately adjoining the front of said lots, or either of them, as will make the angles at the four corners of Sixteenth and K streets, northwest, right angles, upon payment into the Treasury of the United States by said owners, or each of them, of an amount for the number of feet in each lot so to be conveyed at the rate the same may be appraised by three disinterested freeholders resident of the city of Washington, to be selected and sworn to said Chief of Engineers impartially to appraise said real estate at the true value thereof in money; and upon said sale the owners of said lots respectively shall pay into the Treasury of the United States, for the erection of school-buildings in the city of Washington, one-third of said purchase-money, and the remainder thereof, with interest, in one year from the date of sale. No conveyance shall be made until all the purchase-money is paid: *Provided*, That said Chief of Engineers shall not sell or convey one portion or any part of said real estate unless all the same is sold and conveyed.

Approved, March 2, 1881.

March 3, 1881.

CHAP. 130.—An act making appropriations for the legislative, executive, and judicial expenses of the government for the fiscal year ending June thirtieth, eighteen hundred and eighty-two, and for other purposes.

Appropriations.

Legislative, executive, and judicial.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, out of any money in the Treasury not otherwise appropriated, in full compensation for the service of the fiscal year ending June thirtieth, eighteen hundred and eighty-two, for the objects hereinafter expressed, namely:

* * * * * * *

War Department.

WAR DEPARTMENT.

* * * * * * *

Office Public Buildings and Grounds.

PUBLIC BUILDINGS AND GROUNDS.

Clerk and messenger.

For clerk in the Office of Public Buildings and Grounds, one thousand four hundred dollars; and for messenger in the same office, eight hundred and forty dollars.

Public gardener.

For the public gardener, one thousand six hundred dollars.

Foreman and laborers.

For a foreman and laborers employed in the public grounds, twenty-four thousand dollars.

Navy-yard and Upper Bridges, draw-keepers.

For two draw-keepers for Navy-Yard and Upper Bridges, one thousand four hundred and forty dollars.

Franklin Square, watchman.

For watchman in Franklin Square, six hundred and sixty dollars.

Lafayette Square, watchman.

For watchman in Lafayette Square, six hundred and sixty dollars.

Smithsonian Grounds, watchmen.

For two day-watchmen in Smithsonian Grounds, at six hundred and sixty dollars each, one thousand three hundred and twenty dollars.

For two night-watchmen in Smithsonian Grounds, at seven hundred and twenty dollars each, one thousand four hundred and forty dollars.

Judiciary and Lincoln Squares, watchmen.

For one watchman for Judiciary Square, and one for Lincoln Square and adjacent reservations, at six hundred and sixty dollars each, one thousand three hundred and twenty dollars.

Iowa Circle, Fourteenth-street Circle, etc., watchmen.

For one watchman for Iowa Circle, one watchman for Fourteenth-street Circle and neighboring reservations, one for Rawlins Square and Washington Circle, one watchman for McPherson and Farragut Squares, and one for Stanton Place and neighboring reservations, five in all, at six hundred and sixty dollars each, three thousand three hundred dollars: *Provided*, That each of the watchmen herein provided for shall have the same duties and powers of the Metropolitan police.

Proviso.

Bridge-keeper at Chain Bridge.

For one bridge-keeper at Chain Bridge, six hundred and sixty dollars.

Contingent expenses.

For contingent and incidental expenses, five hundred dollars.

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Approved, March 3, 1881.

March 3, 1881.

CHAP. 133.—An act making appropriations for sundry civil expenses of the government for the fiscal year ending June thirtieth, eighteen hundred and eighty-two, and for other purposes.

Appropriations. Sundry civil expenses.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated for the objects hereinafter expressed, for the fiscal year ending June thirtieth, eighteen hundred and eighty-two, namely:

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UNDER THE WAR DEPARTMENT.

* * * * * * *

BUILDINGS AND GROUNDS IN AND AROUND WASHINGTON AND THE EXECUTIVE MANSION.

Improvement and care of public grounds.

Improvement and care of public grounds: For filling in and improving grounds south of Executive Mansion, ten thousand dollars.

For ordinary care of greenhouses and the nursery, one thousand five hundred dollars.

For ordinary care of Lafayette Square, one thousand dollars.

For care and improvement of reservation number three (Monument Grounds), one thousand dollars.

For construction and repair of iron fences, five hundred dollars.

For manure, and hauling the same, four thousand dollars.

For painting iron fences, vases, lamps, and lamp-posts, one thousand five hundred dollars.

For purchase and repair of seats, five hundred dollars.

For purchase and repair of tools, five hundred dollars.

For trees, tree-stakes, lime, whitewashing, and stock for nursery, three thousand dollars.

For removing snow and ice, one thousand dollars.

For flower-pots, twine, baskets, and lycopodium, one thousand dollars.

For care and construction and repair of fountains in the public grounds, one thousand five hundred dollars.

For abating nuisances, five hundred dollars.

For improving various reservations, twelve thousand dollars.

For ordinary care of Smithsonian Grounds, two thousand dollars.

For asphaltum foot-walks through Smithsonian Grounds from Seventh to Twelfth streets, one thousand five hundred dollars.

Executive Mansion.

Executive Mansion: For care of and repairs to the Executive Mansion, and for furniture, thirty thousand dollars; for constructing elevator in the Executive Mansion, two thousand dollars, to be available immediately; fuel for the Executive Mansion and the greenhouses, two thousand dollars; care and necessary repairs of the greenhouses, five thousand five hundred dollars; in all, thirty-nine thousand five hundred dollars.

Lights, etc.

Lighting the Executive Mansion and public grounds: For gas, pay of

Proviso.

lamp-lighters, gas-fitters, plumbers, plumbing, lamp-posts, matches, and repairs of all kinds; fuel for office, for the watchmen's lodges, and for the green-houses in the nursery, fifteen thousand dollars: *Provided*, That for each burner not connected with a meter in the lamps on the public grounds no more than twenty-five dollars shall be paid per lamp for gas, including lighting, cleaning, and keeping in repair the lamps, under any expenditure provided for in this act; and in case a contract cannot be made at that rate the engineer in charge is hereby authorized to substitute other illuminating material in the lamps on the public grounds, and to use so much of the sum hereby appropriated as may be necessary for that purpose.

Water-pipes, etc.

Repair of water-pipes and fire-plugs: For repairing and extending water-pipes, purchase of apparatus to clean them, and for cleaning the springs and repairing and renewing the pipes of the same that supply the Capitol, the Executive Mansion, and the building for the State, War, and Navy Departments, two thousand five hundred dollars.

Telegraph.

Telegraph to connect the Capitol with the departments and the Government Printing Office: For repair and care of the same, one thousand dollars.

Building for State, War, and Navy Departments.

Building for State, War, and Navy Departments: For continuing the construction of the building; to cover inside iron-work; plumbing and gas-fitting; granite stairs; heating apparatus; plastering and stucco-work; materials for approaches; lumber for doors, sash, and flooring; labor and contingencies, four hundred and fifty thousand dollars.

Washington Monument.

Continuation of the Washington Monument: Earth embankments, marble, granite, iron frame-work, machinery, tools, labor, and office expenses, one hundred and fifty thousand dollars.

MISCELLANEOUS OBJECTS UNDER THE WAR DEPARTMENT.

* * * * * * *

Survey of northern and northwestern lakes.

Survey of northern and northwestern lakes: For water-level observations and reductions, comparisons of standards of base apparatus and reductions, printing and issuing charts for use of navigators, completion of publication of final report, office-rent, clerk-hire, fuel, and miscellaneous, eighteen thousand dollars; and the unexpended balance, not exceeding eight thousand dollars, of the appropriation for survey of northern and northwestern lakes for the fiscal year eighteen hundred and eighty-one is hereby reappropriated and made available for the same purpose.

* * * * * * *

Mississippi River Commission.

Mississippi River Commission: For salaries and traveling expenses of Commission, office expenses, and reduction of work; for continuation of surveys and gaugings of Mississippi River and its tributaries; for permanent gauge-stations and borings; for publication of maps and results, one hundred and fifty thousand dollars.

* * * * * * *

Surveys of Maryland and Delaware peninsula.

For the expenses of the surveys to be made across the peninsula of Maryland and Delaware to connect by canal the waters of the Delaware and Chesapeake Bays, under the direction of the Secretary of War, ten thousand dollars.

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Approved March 3, 1881.

March 3, 1881.

CHAP. 134.—An act making appropriations to provide for the expenses of the government of the District of Columbia for the fiscal year ending June thirtieth, eighteen hundred and eighty-two, and for other purposes.

District of Columbia.
Appropriations.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the half of the following sums named, respectively, is hereby appropriated, out of any money in the Treasury not otherwise appropriated, and the other half out of the revenues of the District of Columbia, for the purposes following, being the estimated expenses of the government of the District of Columbia for the fiscal year ending June thirtieth, eighteen hundred and eighty-two, namely:

* * * * * * *

Benning's, Anacostia, and Chain Bridges.

For ordinary care of Benning's, Anacostia, and Chain Bridges, two thousand dollars; for maintenance and repair of other bridges, five hundred dollars.

WASHINGTON AQUEDUCT.

Washington Aqueduct.

For engineering, maintenance, and general repairs, twenty thousand dollars.

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FOR SALARIES AND CONTINGENT EXPENSES.

* * * * * * *

Compensation of Engineer Commissioner.

And hereafter the Engineer Commissioner shall be entitled to receive such compensation, in addition to his Army pay and allowances, as will make his compensation equal to five thousand dollars per annum, and a sum sufficient to pay said additional compensation is hereby appropriated.

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INTEREST AND SINKING-FUND.

Sale of lands in city of Washington; proceeds of sale to be applied to erection of high-school building.

SEC. 4. That the Chief of Engineers, United States Army, in charge of public buildings and grounds in the District of Columbia, be, and is hereby, authorized to sell and convey, by good and sufficient deed, to each of the owners of lot one, square one hundred and eighty-four; lot five, square one hundred and eighty-five; lots five, six, and seven, square one hundred and ninety-eight; lot twelve, square one hundred and ninety-nine, in the city of Washington, District of Columbia, such portion of the ground immediately adjoining the front of said lots, or either of them, as will make the angles at the four corners of Sixteenth and K streets, northwest, right angles, upon payment into the Treasury of the United States by said owners, or each of them, of an amount for the number of feet in each lot so to be conveyed at the rate the same may be appraised by three disinterested freeholders resident of the city of Washington, to be selected and sworn by said Chief of Engineers impartially to appraise said real estate at the true value thereof in money; and upon said sale, the owners of said lots respectively shall pay into the Treasury of the United States, for the erection of a high-school building in the city of Washington, one-third of said purchase money, and the remainder thereof, with interest, in one year from the date of sale. No conveyance shall be made until all the purchase-money is paid: *Provided*, That said Chief of Engineers shall not sell or convey one portion or any part of said real estate unless all the same is sold and conveyed.

Proviso.

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Approved, March 3, 1881.

March 3, 1881.

CHAP. 135.—An act making appropriations for fortifications and other works of defense, and for the armament thereof, for the fiscal year ending June thirtieth, eighteen hundred and eighty-two, and for other purposes.

Appropriations. Forts and fortifications.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the sum of one hundred and seventy-five thousand dollars be, and the same is hereby, appropriated, out of any money in the Treasury not otherwise appropriated, for the protection, preservation, and repair of fortifications and other works of defense, for the fiscal year ending June thirtieth, eighteen hundred and eighty-two, the same to be expended under the direction of the Secretary of War; and the Secretary of War is directed to make report of the condition of the fortifications, and what number of them, if any, can be dispensed with, also, the following for the armament of fortifications, namely:

Secretary of War to make report, etc.

Armament, etc.

For the armament of sea-coast fortifications, including heavy guns and howitzers for flank defense, carriages, projectiles, fuses, powder, and implements, their trial and proof, and all necessary expenses incident thereto, and for machine guns, including the conversion of smoothbore cannon into rifles, three hundred and twenty-five thousand dollars. And the President is authorized to select a board, to consist of one engineer officer, two ordnance officers, and two officers of artillery, whose duty it shall be to make examinations of all inventions of heavy ordnance and improvements of heavy ordnance and projectiles that may be presented to them, including guns now being constructed or converted under direction of the Ordnance Bureau; and said board shall

President to select board of Army officers to examine ordnance, etc., and report, with recommendations.

make detailed report to the Secretary of War, for transmission to Congress, of such examination, with recommendation as to what inventions are worthy of actual test, and the estimated cost of such test; and the sum of twenty-five thousand dollars, or so much thereof as may be necessary, is hereby appropriated for such purpose.

Torpedoes.

Proviso.

For torpedoes for harbor defenses, and the preservation of the same, and for torpedo experiments in their application to harbor and land defense, and for instruction of engineer battalion in their preparation and application, fifty thousand dollars: *Provided*, That the money herein appropriated for torpedoes shall only be used in the establishment and maintenance of torpedoes to be operated from shore stations for the destruction of an enemy's vessel approaching the shore or entering the channels and fairways of harbors.

Exchange or sale of unserviceable powder and shot.

And the Secretary of War is hereby authorized, in his discretion, to exchange the unserviceable and unsuitable powder and shot on hand for new powder and projectiles, or to sell the same and purchase similar articles with the proceeds of the sales; and he shall make statement of his action under this provision in his next annual report.

Approved, March 3, 1881.

March 3, 1881.

CHAP. 136.—An act making appropriations for the construction, completion, repair, and preservation of certain works on rivers and harbors, and for other purposes.

Appropriations. Rivers and harbors:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums of money be, and are hereby, appropriated, to be paid out of any money in the Treasury not otherwise appropriated, and to be expended under the direction of the Secretary of War, for the construction, completion, repair, and preservation of the public works hereinafter named:

Richmond Island Harbor.

Improving Richmond Island Harbor, Maine: Completing improvement, three thousand dollars.

Portsmouth Harbor.

Improving harbor at Portsmouth, New Hampshire, twenty thousand dollars.

Burlington Harbor.

Improving harbor at Burlington, Vermont, ten thousand dollars.

Swanton Harbor.

Improving harbor at Swanton, Vermont, two thousand five hundred dollars.

Hyannis Harbor.

Improving harbor at Hyannis, Massachusetts: Completing improvement, five thousand dollars.

Newburyport Harbor.

Improving harbor at Newburyport, Massachusetts, forty thousand dollars.

Nantucket Harbor.

Improving harbor at Nantucket, Massachusetts, twenty-five thousand dollars.

Plymouth Harbor.

Improving harbor at Plymouth, Massachusetts, ten thousand dollars.

Provincetown Harbor.

Improving harbor at Provincetown, Massachusetts, five thousand dollars.

Little Narragansett Bay.

Improving Little Narragansett Bay, Rhode Island, five thousand dollars.

Bridgeport Harbor.

Improving harbor at Bridgeport, Connecticut, ten thousand dollars.

New Haven Harbor.

Improving harbor at New Haven, Connecticut, fifteen thousand dollars.

New Haven Breakwater.

Breakwater at New Haven, Connecticut, sixty thousand dollars.

Norwalk Harbor.

Improving harbor at Norwalk, Connecticut, five thousand dollars.

Southport Harbor.

Improving harbor at Southport, Connecticut, two thousand five hundred dollars.

Boston Harbor etc.

Improving harbor at Boston, Massachusetts, one hundred thousand dollars; of which sum forty thousand dollars shall be expended in said harbor, thirty-five thousand dollars at the mouth of Charles River in said harbor and up to Watertown, twenty thousand dollars in said harbor at mouth of Mystic River, and five thousand dollars from said harbor to Nantasket Beach.

Oakland Harbor.

Improving Oakland Harbor, California, sixty thousand dollars; and the sums of money heretofore appropriated for this improvement and unexpended are hereby reappropriated; but the sums so appropriated and reappropriated shall not be available until the right of the United

States to the bed of the estuary and training walls of this work is secured, free of expense to the government, in a manner satisfactory to the Secretary of War.

Improving Raritan River, New Jersey, twenty-five thousand dollars; of which sum twenty thousand dollars shall be expended on rocks at Whitehead Sand Dock, and five thousand dollars at South Channel, between Crab Island and South Amboy.

Raritan River.

Improving harbor at Stonington, Connecticut, thirty thousand dollars.

Stonington Harbor.

Improving harbor at Buffalo, New York, ninety thousand dollars.

Buffalo Harbor.

Improving harbor at Charlotte, New York: Repair of piers, two thousand five hundred dollars.

Charlotte Harbor.

Improving Echo Harbor, New Rochelle, New York, three thousand dollars.

Echo Harbor.

Improving Flushing Bay, New York, ten thousand dollars.

Flushing Bay.

Improving harbor at Great Sodus Bay, New York, five thousand dollars.

Great Sodus Bay Harbor.

Improving harbor at Little Sodus Bay, New York, twenty thousand dollars.

Little Sodus Bay Harbor.

Improving harbor at Olcott, New York, three thousand dollars.

Olcott Harbor.

Deepening and widening the channel in Gowanus Bay and the Harbor of New York, forty thousand dollars.

Channel Gowanus Bay and New York Harbor.

Improving harbor at Port Jefferson, Long Island Sound, New York, four thousand dollars.

Port Jefferson Harbor.

Improving harbor of New Rochelle, New York, twenty thousand dollars.

New Rochelle Harbor.

Improving harbor at Pultneyville, New York, two thousand dollars.

Harbor at Pultneyville.

Improving harbor at Wilson, New York, ten thousand dollars.

Wilson Harbor.

Improving harbor at Waddington, New York, two thousand five hundred dollars.

Waddington Harbor.

Improving Ticonderoga River, New York, five thousand dollars.

Ticonderoga River.

Improving harbor at Erie, Pennsylvania, twenty thousand dollars.

Erie Harbor.

Ice-harbor at Marcus Hook, Pennsylvania, thirty thousand dollars.

Marcus Hook ice-harbor.

Pier in Delaware Bay, near Lewes, Delaware, ten thousand dollars.

Pier, Delaware Bay.

Piers of ice-harbor at New Castle, Delaware: Completing improvement, twenty thousand dollars.

Piers, ice-harbor, New Castle.

Improving harbor at Annapolis, Maryland, five thousand dollars.

Annapolis Harbor.

Improving Breton Bay, Leonardtown, Maryland, three thousand dollars.

Breton Bay.

Improving the harbors and channels at Washington and Georgetown, District of Columbia, fifty thousand dollars.

Washington and Georgetown harbors and channels.

Improving harbor at Norfolk, Virginia, and its approaches, seventy-five thousand dollars.

Norfolk Harbor.

For enlargement and improvement, according to the plan and recommendation of the Engineer Department, of harbor facilities at Oswego, New York, including dredging entrance to harbor, fifty thousand dollars.

Oswego Harbor.

Improving Shrewsbury River, New Jersey: Completing improvement, eighty-six thousand dollars; of which sum thirty-six thousand dollars shall be expended on South Branch, and fifty thousand dollars on Main and North Branch.

Shrewsbury River.

Improving New River from lead mines in Wythe County, Virginia, to mouth of Greenbrier River, twenty-four thousand dollars; of which sum fifteen thousand dollars shall be expended in the continuation of the work from the mouth of Greenbrier up, and nine thousand dollars in the continuation of the work from the lead mines in Wythe County down.

New River.

Improving harbor at Charleston, South Carolina, one hundred and seventy-five thousand dollars.

Charleston Harbor.

Improving harbor at Brunswick, Georgia, five thousand dollars.

Brunswick Harbor.

Improving Savannah Harbor and River, Georgia, sixty-five thousand dollars; of which sum one thousand dollars may be applied to payment of damages for land taken for widening the channel opposite Savannah.

Savannah Harbor and River.

Improving Apalachicola Bay, Florida, ten thousand dollars.

Apalachicola Bay.

Tampa Bay.

Improving Tampa Bay, Florida: Completing the deepening of the bar and channel from the bar to the town of Tampa, ten thousand dollars.

Mobile Harbor.

Improving harbor at Mobile, Alabama, one hundred thousand dollars.

Mississippi River and Harbor.

Improving Mississippi River at and near Vicksburgh, and protection of harbor of Vicksburgh, Mississippi, seventy-five thousand dollars.

New Orleans Harbor.

Improving harbor at New Orleans, Louisiana, seventy-five thousand dollars.

Galveston Harbor.

Improving Galveston Harbor, Texas: Continuing operations at outer bar, two hundred and fifty thousand dollars.

Ashtabula Harbor.

Improving harbor at Ashtabula, Ohio: To secure a sixteen-foot channel, twenty thousand dollars.

Black River Harbor.

Improving harbor at Black River, Ohio, seven thousand dollars.

Cleveland Harbor.

Improving harbor at Cleveland, Ohio, two hundred thousand dollars.

Fairport Harbor.

Improving harbor at Fairport, Ohio, ten thousand dollars.

Huron Harbor.

Improving harbor at Huron, Ohio, three thousand dollars.

Ice-harbor, Muskingum River.

Ice-harbor at mouth of Muskingum River, Ohio, thirty thousand dollars.

Harbors at—
Port Clinton;
Sandusky City;
Toledo;
Vermillion;
Michigan City;
Calumet;
Chicago.

Improving harbor at Port Clinton, Ohio, five thousand dollars.

Improving harbor at Sandusky City, Ohio, ten thousand dollars.

Improving harbor at Toledo, Ohio, forty thousand dollars.

Improving harbor at Vermillion, Ohio, two thousand dollars.

Improving harbor at Michigan City, Indiana: Continuing operations at outside harbor, twenty thousand dollars; for continuing improvement on the inner harbor, twenty-five thousand dollars.

Improving harbor at Calumet, Illinois, thirty thousand dollars.

Improving outside harbor at Chicago, Illinois: Dredging in outer harbor and constructing exterior breakwater, one hundred and fifty thousand dollars.

Galena River and Harbor.

Improving Galena River and Harbor, Illinois, twelve thousand dollars.

Rock Island Harbor.

Improving harbor at Rock Island, Illinois, six thousand dollars.

Monongahela River.

Improving Monongahela River, West Virginia and Pennsylvania, twenty-five thousand dollars; but this sum shall not be expended until the Monongahela Navigation Company shall have undertaken in good faith the building of lock and dam number seven at Jacob's Creek, and until said company shall, in manner satisfactory to the Secretary of War, give assurance of their ability and purpose to complete the same.

Shenandoah River.

Improving Shenandoah River, West Virginia, two thousand five hundred dollars; but this sum shall not be expended, nor shall the sum hereheretofore appropriated therefor be expended, until any corporate rights or franchies that may exist over said river shall have been relinquished to the United States to the satisfaction of the Secretary of War.

Waukegan Harbor.

Improving harbor at Waukegan, Illinois, fifteen thousand dollars.

Ice-harbor, Saint Louis.

Ice-harbor at Saint Louis, Missouri, ten thousand dollars.

Memphis Harbor.

Improving harbor and the Mississippi River at Memphis, Tennessee, fifteen thousand dollars.

Au Sable Harbor.

Improving harbor and river at Au Sable, Michigan, six thousand dollars.

Charlevoix Harbor.

Improving harbor at Charlevoix, Michigan, ten thousand dollars.

Cheboygan Harbor.

Improving harbor at Cheboygan, Michigan, six thousand dollars.

Frankfort Harbor.

Improving harbor at Frankfort, Michigan, ten thousand dollars.

Harbors at—
Grand Haven;
Black Lake.

Improving harbor at Grand Haven, Michigan, fifty thousand dollars.

Improving harbor at Black Lake, Michigan: Continuing operations for completion of old project, six thousand dollars.

Harbor of refuge at—
Grand Marais;
Lake Huron.

Harbor of refuge at Grand Marais, Michigan, twenty thousand dollars.

Harbor of refuge at Lake Huron, Michigan, fifty thousand dollars.

Harbors at—
Ludington;
Manistee;

Improving harbor at Ludington, Michigan, ten thousand dollars.

Improving harbor at Manistee, Michigan, ten thousand dollars.

Manistique;

Improving Manistique Harbor, Michigan: Completing improvement, one thousand dollars.

Monroe;

Improving harbor at Monroe, Michigan, one thousand dollars.

Muskegon;

Improving harbor at Muskegon, Michigan, twenty thousand dollars.

Ontonagon;

Improving harbor at Ontonagon, Michigan, twenty thousand dollars.

Pentwater.

Improving harbor at Pentwater, Michigan, ten thousand dollars.

Harbor of refuge, Portage Lake.

Harbor of refuge at Portage Lake, Michigan, ten thousand dollars.

Saint Joseph Harbor and River.

Improving river and harbor at Saint Joseph, and water-channel leading up to Benton Harbor, Michigan, ten thousand dollars.

Saugatuck Harbor.

Improving harbor at Saugatuck, Michigan, five thousand dollars.

South Haven Harbor.

Improving harbor at South Haven, Michigan, five thousand dollars.

White River Harbor.

Improving harbor at White River, Michigan, seven thousand five hundred dollars.

Grand River.

Improving Grand River from its mouth to the city of Grand Rapids, Michigan, ten thousand dollars.

Clinton River.

Continuing improvement of Clinton River, Michigan, eight thousand dollars.

Ice-harbor refuge, Belle River removing bar.

Removing bar at ice-harbor of refuge at Belle River, Michigan, seven thousand dollars.

Ahnapee Harbor.

Improving harbor at Ahnapee, Wisconsin, eight thousand dollars.

Green Bay Harbor.

Improving harbor at Green Bay, Wisconsin, five thousand dollars.

Kenosha Harbor.

Improving harbor at Kenosha, Wisconsin, five thousand dollars.

Ohio River, Davis Islan Dam.

Proviso.

Indiana Chute.

Grand Chain.

Improving Ohio River, three hundred and fifty thousand dollars; of which sum one hundred and fifty thousand dollars may, in the discretion of the engineers, be expended on Davis Island Dam, and two hundred thousand dollars on the river from its mouth to its head: *Provided*, That fifty thousand dollars of the last-named sum may, in the discretion of the engineers, be expended on Indiana Chute; and fifty thousand dollars of the last named sum, or so much thereof as shall be necessary, shall be applied to the completion of the work on Grand Chain.

Harbors at—

Manitowoc;

Improving harbor at Manitowoc, Wisconsin, four thousand dollars.

Menomonee;

Improving harbor at Menomonee, Wisconsin, twelve thousand dollars.

Milwaukee;

Improving harbor at Milwaukee, Wisconsin: Extension and repairs of piers and dredging. eight thousand dollars.

Port Washington;

Improving harbor at Port Washington, Wisconsin, seventeen thousand dollars.

Racine;

Improving harbor at Racine, Wisconsin, six thousand dollars.

Sheboygan;

Improving harbor at Sheboygan, Wisconsin: Repairs, dredging, and extension of piers, twenty-five thousand dollars.

Superior Bay.

Improving Superior Bay, Wisconsin: Dredging for improvement of natural entrance and for repairing existing works, ten thousand dollars.

Sturgeon Bay Canal, harbor of refuge.

Harbor of refuge at Sturgeon Bay Canal, Wisconsin, ten thousand dollars.

Two Rivers Harbor.

Improving harbor at Two Rivers, Wisconsin, fifteen thousand dollars.

Oconto Harbor.

Improving harbor at Oconto, Wisconsin, ten thousand dollars.

Fort Madison Harbor.

Improving harbor at Fort Madison, Iowa, two thousand five hundred dollars.

Muscatine Harbor.

Improving harbor at Muscatine, Iowa, two thousand five hundred dollars.

Harbors at—

Grand Marais;

Improving harbor at Grand Marais, Minnesota, twenty thousand dollars.

Duluth;

Improving harbor at Duluth, Minnesota, forty thousand dollars.

Wilmington;

Improving harbor at Wilmington, California, thirty-three thousand dollars.

Humboldt.

Improving Humboldt Harbor and Bay, forty thousand dollars.

Cathance River.

Improving Cathance River, Maine, six thousand dollars.

"Gut," opposite Bath, Me.

Improving the "Gut," opposite Bath, Maine, five thousand dollars.

Kennebunk River.

Improving Kennebunk River, Maine: Completing improvement, two thousand dollars.

Lubec Channel.

Improving Lubec Channel, Maine, forty-five thousand dollars.

Exeter River—"Ox Bow."

Improving Exeter River, New Hampshire, fifteen thousand dollars; of which sum an amount not exceeding seven hundred and fifty dollars shall be available immediately, to be used in acquiring title to land used in the cut-off at "Ox Bow."

Lamprey River.

Improving Lamprey River, New Hampshire, below New Market, ten thousand dollars.

Winnipiseogee Lake.

Proviso.

Improving Winnipiseogee Lake, New Hampshire: Completing improvement, two thousand five hundred dollars: *Provided*, That no right to raise or lower the water-level of said lake is hereby granted to any person or corporation.

Otter Creek.

Improving Otter Creek, Vermont, two thousand dollars.

Merrimac River.

Improving Merrimac River, Massachusetts, nine thousand dollars.

Taunton River.

Improving Taunton River, Massachusetts, twenty-five thousand dollars.

Providence River and Narragansett Bay.

Improving Providence River and Narragansett Bay, Rhode Island, sixty thousand dollars.

Potonowut River.

Improving Potonowut River, Rhode Island, five thousand dollars.

Milwaukee Bay.

Improving Milwaukee Bay, for purposes of harbor of refuge, one hundred thousand dollars.

Mississippi, Missouri, and Arkansas Rivers.

Proviso.

Improving Mississippi, Missouri, and Arkansas Rivers: Removing snags, wrecks, and other obstructions, one hundred and eighty-five thousand dollars; of which sum eighty thousand dollars shall be expended on the Mississippi River, eighty thousand dollars on the Missouri River, and twenty-five thousand dollars on the Arkansas River. And the work herein provided for shall be prosecuted at all seasons of the year, and especially between the first day of July and the first day of November of each year: *Provided*, That so much of said sum of eighty thousand dollars hereby appropriated to the Missouri River as may be necessary shall be expended in the construction of a snag and dredge boat to be used in said river, the balance of said eighty thousand dollars to be expended in operating said boat.

Chippewa River.

1879, ch. 181, Stat. 20, 372.

Improving Chippewa River, Wisconsin, ten thousand dollars; but this sum is appropriated subject to the same conditions and limitations imposed by section one of the act approved March third, eighteen hundred and seventy-nine, for the improvement of rivers and harbors, relating to said Chippewa River.

Connecticut River.

Improving Connecticut River below Hartford, Connecticut, thirty thousand dollars; of which sum ten thousand dollars shall be used to continue the work in progress on the bar at the mouth of the river, and three thousand dollars in dredging the channel below Rocky Hill.

Housatonic River.

Improving Housatonic River, Connecticut, two thousand dollars.

Thames River.

Improving Thames River, Connecticut, thirty thousand dollars.

New London Harbor.

Improving New London Harbor, Connecticut, four thousand three hundred dollars.

East River, Hell Gate, removing obstructions.

Removing obstructions in East River and Hell Gate, New York, two hundred thousand dollars.

Buttermilk Channel.

Improving Buttermilk Channel, New York, sixty thousand dollars.

Hudson River.

Improving Hudson River, New York, fifteen thousand dollars.

Cheesequake's Creek.

Improving Cheesequake's Creek, New Jersey, five thousand dollars.

Cohansey Creek.

Improving Cohansey Creek, New Jersey, seven thousand dollars.

Elizabeth River.

Improving Elizabeth River, New Jersey, four thousand dollars.

Passaic River.

Improving Passaic River, New Jersey, from Pennsylvania Railroad bridge to its mouth, fifty thousand dollars.

Rahway River.

Improving Rahway River, New Jersey, ten thousand dollars.

South River.

Improving South River, New Jersey, six thousand dollars.

Woodbridge Creek.

Improving Woodbridge Creek, New Jersey; Continuing improvement, five thousand dollars.

Allegheny River.

Improving Allegheny River from mouth of French Creek to Pittsburgh, Pennsylvania, twenty-five thousand dollars.

Schuylkill River.

Improving Schuylkill River, Pennsylvania, forty thousand dollars.

Delaware River.

Improving Delaware River below Bridesburg, Pennsylvania, one hundred thousand dollars.

Improving Delaware River between Trenton, New Jersey, and Bridesburg, Pennsylvania, ten thousand dollars.

Improving Delaware River near Cherry Island Flats, one hundred thousand dollars.

Improving Delaware River at Schooner Ledge, Pennsylvania and Delaware, forty thousand dollars.

Broadkiln River.

Improving Broadkiln River, Delaware, five thousand dollars.

Mississippi River.

Ex. Document 58, 2d Sess. 46 Cong.

General and permanent improvement.

Proviso.

Report.

For the improvement of the Mississippi River, in accordance with the plan therefor recommended in Executive Document number fifty-eight, second session Forty-sixth Congress, by the Mississippi River Commission, to be expended by the Secretary of War, with the advice and under the supervision of said commission, the sum of one million dollars. And it shall be the duty of said commission to take into consideration, and of the Secretary of War to extend operations, under their supervision, to tributaries of the Mississippi River to the extent, and no further, that may be necessary in the judgment of said commission to the perfection of the general and permanent improvement of said Mississippi River; but this clause shall not be construed to interfere with the prosecution by the War Department of the improvement of said Mississippi River and its tributaries under general appropriations made therefor: *Provided*, That no portion of the sum hereby appropriated shall be used in the repair or construction of levees for the purpose of preventing injury to lands by overflow, or for any other purpose whatever except as a means of deepening or improving the channel of said river. And it shall be the duty of said commission to make report, on or before the first day of January next, to the Secretary of War, for transmission by him to Congress, of a detailed statement of the work done, and of the expenditure made from the sum hereby appropriated, with their judgment upon the effect of such work, and the general practicability and estimate of the total cost of such improvements along said river from Cairo to the head of the passes.

Broad Creek.

Improving Broad Creek from its mouth to Laurel, Delaware, ten thousand dollars.

Duck Creek.

Improving mouth of Duck Creek, Delaware, three thousand dollars.

Mispillion Creek.

Improving Mispillion Creek, Delaware, three thousand five hundred dollars.

Choptank River.

Improving Choptank River between Denton and Greensborough, Maryland, five thousand dollars.

Elk River.

Improving Elk River, Maryland, five thousand dollars.

Secretary Creek.

Improving Secretary Creek, Maryland, three thousand dollars.

Threadhaven Creek.

Improving Threadhaven Creek for three miles below Easton, Maryland three thousand dollars.

Wicomico River.

Improving Wicomico River below Salisbury, Maryland: Completing improvement, two thousand dollars.

Chester River.

Improving Chester River from Spry's Landing to Crumpton, Maryland, six thousand five hundred dollars.

Water passage, Deal's Island.

Improving water-passage between Deal's Island and Little Deal's Island, Maryland, five thousand dollars.

Appomattox River.

Improving Appomattox River, Virginia, twenty thousand dollars to be expended on the improvement of the river and harbor at Petersburg, Virginia.

Blackwater River.

Improving Blackwater River, Virginia, one thousand five hundred dollars.

Chickahominy River.

Improving Chickahominy River, Virginia, two thousand dollars.

Dan River.

Improving Dan River between Danville, Virginia, and Madison, North Carolina, eight thousand dollars.

James River.

Improving James River, Virginia, sixty thousand dollars.

Mattaponi River.

Improving Mattaponi River, Virginia, three thousand three hundred dollars.

Nomoni Creek.

Improving mouth of Nomoni Creek, Virginia, two thousand dollars.

North Landing River.

Improving North Landing River, Virginia and North Carolina, seven thousand five hundred dollars.

Nottaway River.

Improving Nottaway River, Virginia, two thousand dollars.

Pagan Creek.

Improving Pagan Creek, Virginia, five thousand dollars.

Pamunkey River.

Improving Pamunkey River, Virginia, two thousand five hundred dollars.

Channel at Mount Vernon, Va.

Dredging a channel through the flats in front of Mount Vernon, Virginia, one thousand five hundred dollars.

Rappahannock River.
Improving Rappahannock River, Virginia, fifteen thousand dollars.

Staunton River.
Improving Staunton River, Virginia, five thousand dollars.

Totuski River.
Improving Totuski River, Virginia, two thousand five hundred dollars.

Urbana Creek.
Improving Urbana Creek, Virginia, four thousand dollars.

York River.
Improving York River at West Point, Virginia, twenty-five thousand dollars.

Baltimore Harbor.
Improving harbor at Baltimore, Maryland: Continuing operations for the shortening and deepening the channel to twenty-seven feet at mean low water, one hundred and fifty thousand dollars.

Elk River.
Improving Elk River, West Virginia, five thousand dollars.

Great Kanawha River.
Improving Great Kanawha River, and operation of works, West Virginia, two hundred thousand dollars.

Guyandotte River.
Improving Guyandotte River, West Virginia, three thousand five hundred dollars.

Little Kanawha River.
Proviso.
Little Kanawha Navigation Company.
Improving Little Kanawha River, West Virginia, forty thousand dollars: *Provided*, That no tolls shall be collected by the Little Kanawha Navigation Company for that part of the river improved by the general government.

Cape Fear River.
Improving Cape Fear River, North Carolina, from the ocean to Wilmington, one hundred and forty thousand dollars.

Proviso.
Proviso.
Proviso.
Improving the Cape Fear River from Wilmington to Fayetteville, North Carolina, thirty thousand dollars: *Provided*, That the Secretary of War is directed to expend of the money hereby appropriated, a sum not exceeding ten thousand dollars, to extinguish any claim of right held by any company or corporation, to take tolls or make charges for the navigation of so much of said river as is above described; *And provided further*, That said claim of right shall be extinguished and released on or before the first day of December, eighteen hundred and eighty one, and no part of this appropriation shall be expended in the improvement of said river until such claim or right is wholly extinguished and released: *Provided further*, That nothing herein contained shall be taken or held as a waiver on the part of the United States to the exclusive control of navigation of said river relieved from any charges or tolls imposed by any company or corporation.

Currituck Sound.
Improving Currituck Sound, Coanjok Bay, North River and Bar, North Carolina, thirty thousand dollars.

French Broad River.
Improving French Broad River, North Carolina, five thousand dollars.

Neuse River.
Improving Neuse River from its mouth to head of navigation, North Carolina, thirty thousand dollars.

Pamlico and Tar Rivers,
Improving Pamlico and Tar Rivers, North Carolina, eight thousand dollars.

Scuppernong River.
Improving Scuppernong River, North Carolina, one thousand dollars.

Trent River.
Improving Trent River, North Carolina, five thousand dollars.

Yadkin River.
Improving Yadkin River, North Carolina, twelve thousand dollars.

Contentnia Creek.
Improving Contentnia Creek, North Carolina, ten thousand dollars.

Beaufort Harbor.
Improving Beaufort Harbor, North Carolina, thirty thousand dollars.

Lillington River.
Improving Lillington River, North Carolina, three thousand dollars.

Ashley River.
Improving Ashley River, South Carolina, one thousand five hundred dollars.

Great Pedee River.
Improving Great Pedee River, South Carolina, between Little Bluff and Cheraw, six thousand dollars.

Waccemaw River.
Improving Waccemaw River, South Carolina, from its mouth up to Waccemaw Lake, North Carolina, ten thousand dollars.

Town Creek.
Improving Town Creek, in North Carolina, one thousand dollars.

Chattahoochie River.
Improving Chattahoochie River, Georgia, twenty thousand dollars.

Coosa River.
Improving Coosa River, Georgia and Alabama, sixty thousand dollars.

Flint River.
Improving Flint River, Georgia, fifteen thousand dollars.

Ockmulgee River.
Improving Ockmulgee River, Georgia, five thousand dollars.

Oconee River.
Improving Oconee River, Georgia, two thousand five hundred dollars; of which sum one thousand five hundred dollars to be expended between Dublin and Oconee Bridge.

Improving Oostenaula and Coosawattee Rivers, Georgia, one thousand dollars.

Oostenaula and Coosawattee Rivers.

Improving Savannah River above Augusta, Georgia, eight thousand dollars.

Savannah River.

Improving Apalachicola River, Florida, one thousand five hundred dollars.

Apalachicola River.

Improving Choctawhatchee River, Florida and Alabama, up to Newton, ten thousand dollars.

Choctawhatchee River.

Improving entrance to Cumberland Sound, between Amelia and Cumberland Islands, Florida and Georgia, one hundred thousand dollars.

Cumberland Sound.

Improving Escambia River, Florida and Alabama, five thousand dollars.

Escambia River.

Improving Saint John's River, Florida, one hundred thousand dollars.

Saint John's River.

Improving Pea's Creek, in Florida, seven thousand dollars.

Pea's Creek.

Improving Withlacooche River, in Florida, seven thousand five hundred dollars.

Withlacooche River.

Improving Suwanee River, Florida, three thousand dollars.

Suwanee River.

Improving Volusia Bar, Florida, five thousand five hundred dollars.

Volusia Bar.

Improving Alabama River, Alabama, twenty thousand dollars.

Alabama River.

Improving Big Sunflower River, Mississippi, four thousand dollars.

Big Sunflower River.

Improving Noxubee River, Mississippi, eight thousand dollars.

Noxubee River

Improving Pascagoula River, Mississippi, four thousand dollars.

Pascagoula River.

Improving Pearl River below Jackson, Mississippi, twenty-five thousand dollars.

Pearl River.

Improving Pearl River, Mississippi, from Jackson to Carthage, two thousand five hundred dollars.

Improving Tallahatchee River, Mississippi, three thousand dollars; of which sum two thousand dollars shall be expended above the mouth of Cold Water River to Batesville.

Tallahatchee River.

Improving Tombigbee River above Columbus, Mississippi, one thousand dollars.

Tombigbee River.

Improving Yazoo River, Mississippi, six thousand dollars.

Yazoo River.

Improving Amite River, Louisiana, five thousand dollars.

Amite River.

Improving Bayou Courtableau from Port Barre to Atchafalaya, Louisiana, seven thousand five hundred dollars.

Bayou Courtableau.

Improving Bayou Teche from Saint Martinville to Port Barre, Louisiana, twenty thousand dollars.

Bayou Teche.

Improving Bayou Terrebonne, Louisiana: Completing improvement, eight thousand eight hundred dollars.

Bayou Terrebonne.

Removing raft in Red River and closing Tone's Bayou, Louisiana, ten thousand dollars.

Red River.

Removing obstructions from Red River, Louisiana, ten thousand dollars. And the Secretary of War is hereby directed to cause a thorough survey to be made of the mouth of Red River, and a plan for its permanent improvement to be reported to Congress on or before the first Monday of December, eighteen hundred and eighty-one, with estimates of cost; and said survey and plan to be paid for out of the unexpended balance already appropriated for the mouth of Red River.

Improving Tangipahoa River, Louisiana, two thousand dollars.

Tangipahoa River.

Improving Vermillion River, Louisiana: Completing improvement, four thousand nine hundred dollars.

Vermillion River.

Improving Warrior and Tombigbee Rivers, Alabama and Mississippi, to be expended in the same proportions as the appropriation under the act of June, eighteen hundred and eighty, twenty-five thousand dollars.

Warrior River.

Improving Aransas Pass and Bay, up to Rockport and Corpus Christi, Texas, eighty thousand dollars.

Aransas Pass.

Improving channel over bar at mouth of Brazos River, Texas, forty thousand dollars.

Brazos River, channel at mouth of.

Improving Pass Cavallo Inlet into Matagorda Bay, Texas, sixty thousand dollars.

Pass Cavallo Inlet.

Improving ship-channel, Galveston Bay, Texas, fifty thousand dollars.

Ship-channel, Galveston Bay.

Improving Neches River, Texas, three thousand dollars.

Neches River.

Improving Sabine Pass and Blue Buck Bar, Texas, one hundred and fifty thousand dollars.

Sabine Pass and Blue Buck Bar.

Sabine River. Improving Narrows of Sabine River above Orange, Texas, and to deepen channel at its mouth, seven thousand dollars.

Trinity River. Improving Trinity River, Texas, ten thousand dollars.

Arkansas River. Improving Arkansas River between Fort Smith, Arkansas, and Wichita, Kansas, twenty-four thousand dollars.

Improving Arkansas River at Pine Bluff, Arkansas, twenty-three thousand dollars.

Black River. Improving Black River, Arkansas, and Missouri, six thousand dollars, to be applied from Poplar Bluff.

Fourche Le Fevre River. Improving Fourche Le Fevre River, Arkansas, three thousand dollars.

Ouachita River. Improving Ouachita River, Arkansas and Louisiana, twelve thousand dollars.

Saline River. Improving Saline River, Arkansas, five thousand dollars.

White River. Improving White River between Jacksonport and Buffalo Shoals, Arkansas, eight thousand dollars.

Improving White and Saint Francis Rivers, Arkansas, eight thousand dollars.

Big Hatchee River. Improving Big Hatchee River, Tennessee, three thousand five hundred dollars.

Caney Fork River. Improving Caney Fork River, Tennessee, four thousand dollars.

Clinch River. Improving Clinch River Tennessee, three thousand dollars.

Cumberland River. Improving Cumberland River above Nashville, Tennessee: From Nashville to Kentucky State line, fifteen thousand dollars; from Kentucky line to Smith's Shoals, fifteen thousand dollars; at Smith's Shoals, completing improvement, ten thousand dollars.

Improving Cumberland River below Nashville, Tennessee, fifteen thousand dollars.

Duck River. Improving Duck River, Tennessee, three thousand dollars.

French Broad River. Improving French Broad River above Knoxville, Tennessee, three thousand five hundred dollars.

Hiwassee River. Improving Hiwassee River, Tennessee, one thousand five hundred dollars.

Obed's River. Improving Obed's River, Tennessee, two thousand five hundred dollars.

Tennessee River. Improving Tennessee River above Chattanooga, Tennessee, seven thousand dollars.

Red River. Improving Red River from its mouth to Port Royal, in Montgomery County, Tennessee, five thousand dollars.

Tennessee River, including Muscle Shoals. Improving Tennessee River below Chattanooga, including Muscle Shoals and shoal at Reynoldsburgh; Tennessee and Alabama, two hundred and fifty thousand dollars.

Kentucky River. Improving Kentucky River from its mouth to Three Forks, Kentucky, one hundred and twenty-five thousand dollars.

Big Sandy River. Improving Big Sandy River from Catlettsburgh, Kentucky, to head of navigation, fifty thousand dollars; of which sum forty-six thousand dollars shall be expended at Louisa, and four thousand dollars in the continuation of works on the upper river.

Sandusky River. Improving Sandusky River, Ohio, seven thousand five hundred dollars.

Wabash River. Improving Wabash River, Indiana, fifty thousand dollars, one-half of which is to be used on the river above Vincennes.

White River. Improving White River, Indiana, from Wabash River to Portersville, and to falls on West Fork, twenty thousand dollars.

Illinois River. Improving Illinois River, Illinois, two hundred and fifty thousand dollars.

Mississippi River. Improving Mississippi River at and above Alexandria, Missouri, six thousand dollars.

Improving Mississippi River at or near Cape Girardeau and Minton's Point, Missouri, ten thousand dollars.

Improving Mississippi River from Des Moines Rapids to mouth of Illinois River, Illinois and Missouri, one hundred and seventy-five thousand dollars; and the sums of money heretofore appropriated for the improvement of the Mississippi between the Illinois and Missouri Rivers, and unexpended, are hereby reappropriated, and shall be applied to the improvement of the harbor and Mississippi River at Alton.

Improving Mississippi River between mouths of the Illinois and Ohio Rivers, Illinois and Missouri, six hundred thousand dollars.

Removing bar in Mississippi River opposite Dubuque, Iowa, five thousand dollars.

Completion of work of removing sand-bar in Mississippi River opposite Guttenberg, Iowa, five thousand dollars.

Improving Mississippi River at Hannibal, Missouri, twenty thousand dollars.

Improving Mississippi River at Natchez and Vidalia, Mississippi and Louisiana, fifty thousand dollars.

Improving Mississippi River above Falls of Saint Anthony, Minnesota, ten thousand dollars.

Improving Mississippi River from Saint Paul to Des Moines Rapids, Minnesota, Iowa, Missouri, Illinois, and Wisconsin, two hundred thousand dollars.

Quincy Bay.

Improving Quincy Bay, Illinois, ten thousand dollars.

Gauging waters of Mississippi River.
1871, Res. 40. Stat. 16, 598.

Annual expense of gauging the waters of the Mississippi River and its tributaries: Continuing observations of the rise and fall of the river and its chief tributaries, as required by joint resolution of February twenty-first, eighteen hundred and seventy-one, five thousand dollars.

Upper Mississippi River.

Improving Upper Mississippi River: Operating snag-boat and building light-draught steamer, twenty-five thousand dollars.

Rock Island Rapids.

Improving Rock Island Rapids, Mississippi River, Iowa and Illinois: Completing improvement, eight thousand dollars.

Des Moines Rapids.
Des Moines Rapids Canal.
Saint Mary's Falls Canal.
Saint Clair Flats Canal.
Louisville and Portland Canal.

Improving Des Moines Rapids, Iowa and Illinois, twenty-five thousand dollars. And hereafter, for the purpose of operating and keeping in repair the Des Moines Rapids Canal, and Saint Mary's Falls Canal, and Saint Clair Flats Canal, and the Louisville and Portland Canal, the Secretary of War is authorized to draw his requisition on the Secretary of the Treasury from time to time, which requisition shall be paid out of any money in the Treasury not otherwise appropriated.

Osage River.

Improving the Osage River, Kansas and Missouri, twenty thousand dollars.

Cuivre River.

Improving Cuivre River, Missouri, from mouth to Chain of Rocks, and removing snags and obstructions, five thousand dollars.

Gasconade River.

Improving Gasconade River, Missouri, ten thousand dollars.

Missouri River.

Improving Missouri River at Atchison, Kansas, twenty thousand dollars.

Improving Missouri River from Kansas City to its mouth, thirty-five thousand dollars.

Improving Missouri River at Brownville, Nebraska, ten thousand dollars.

Improving Missouri River at Cedar City, Missouri, fifteen thousand dollars.

Improving Missouri River at Council Bluffs, Iowa, and at Omaha, Nebraska, thirty thousand dollars.

Improving Missouri River at Eastport, Iowa, and at Nebraska City, Nebraska, twenty thousand dollars.

Improving Missouri River at Plattsmouth, Nebraska, ten thousand dollars.

Improving Missouri River at or near Fort Leavenworth, Kansas, eight thousand dollars.

Improving Missouri River at or near Glasgow, Missouri, twenty thousand dollars.

Improving Missouri River at and near Kansas City, Missouri, twenty thousand dollars.

Improving Missouri River at Lexington, Missouri, ten thousand dollars.

Improving Missouri River at Saint Charles, Missouri, fifteen thousand dollars.

Improving Missouri River at and near Saint Joseph, Missouri, twenty thousand dollars.

Improving Missouri River at Sioux City, Iowa: For improvement of channel, seven thousand dollars.

Improving Missouri River at Vermillion, Dakota, fifteen thousand dollars.

Improving Missouri River above mouth of Yellowstone River, Dakota, forty thousand dollars.

Survey of Missouri River.

Survey of Missouri River from its mouth to Fort Benton, Montana: Continuing survey above Sioux City, thirty thousand dollars.

Detroit River.

Improving Detroit River, Michigan, fifty thousand dollars.

Saginaw River.

Improving Saginaw River, Michigan, ten thousand dollars.

Saint Mary's River and Saint Mary's Falls Canal. Improving Saint Mary's River and Saint Mary's Falls Canal, Michigan: Completing improvement, one hundred and fifty thousand dollars.

Saint Anthony's Falls. Repairs and contingencies of public works at Saint Anthony's Falls, Minnesota: To meet repairs necessary, present and prospective, fifteen thousand dollars, which shall be available immediately after the passage of this act.

Saint Croix River. Improving Saint Croix River below Taylor's Falls, Wisconsin, eight thousand dollars.

Red River of the North. Improving Red River of the North, Minnesota and Dakota, eighteen thousand dollars.

Goose Rapids. Constructing a lock and dam at Goose Rapids, on the Red River of the North, Minnesota and Dakota, twenty thousand dollars.

Yellowstone River. Improving Yellowstone River, Montana and Dakota, twenty thousand dollars.

Coos Bay Harbor. Continuing improvement at the entrance of Coos Bay Harbor, Oregon, thirty thousand dollars.

Canal, Cascades of Columbia River. Canal around Cascades of Columbia River, Oregon, one hundred thousand dollars.

Upper Columbia River. Improving Upper Columbia River, including Snake River, Oregon, fifteen thousand dollars.

Lower Willamette. Improving Lower Williamete and Columbia Rivers, from Portland, Oregon, to the sea, including bar at mouth of Columbia River, Oregon, forty-five thousand dollars.

Upper Willamette. Improving Upper Williamette and Yamhill Rivers, Oregon, fifteen thousand dollars.

Petalumas Creek. Improving Petalumas Creek, California, eight thousand dollars.

Sacramento River. Improving Sacramento River, California, sixty thousand dollars.

San Joaquin River. Improving San Joaquin River, California, forty thousand dollars; ten thousand dollars of which amount may be used in the discretion of the engineer in the improvement of Mormon Slough.

Examinations and surveys at South Pass of Mississippi River. Examinations and surveys at South Pass of Mississippi River: To ascertain the depth of water and width of channel secured and maintained from time to time by James B. Eads at South Pass of the Mississippi River, and to enable the Secretary of War to report during the maintenance of the work, ten thousand dollars; and also to ascertain by soundings whether and to what extent, within a distance of five miles from the present mouth of the river at the South Pass, the gulf has filled up by deposits from the river since the construction of the Eads jetties.

Fox and Wisconsin Rivers. Improving Fox and Wisconsin Rivers, Wisconsin, one hundred and twenty-five thousand dollars; of which sum fifty thousand dollars shall be expended in continuing the improvement of the Wisconsin River, and seventy-five thousand for continuing the improvement of the Fox River.

Calcasieu Pass and River. Improving Calcasieu Pass, Louisiana, twelve thousand dollars.

Improving Calcasieu River, Louisiana, from Phillips Bluff to its mouth, three thousand dollars.

Savannah River. Improving Savannah River, Georgia, fifteen thousand dollars.

Mississippi River. Improving Mississippi River at Andalusia, Illinois, six thousand dollars.

Improving Mississippi River at Louisiana, Missiouri, ten thousand dollars.

Saint Croix River. Repairing breakwater on the Saint Croix River near Calais, four thousand dollars.

Altamaha River. Improving Altamaha River, Georgia, five thousand dollars.

Wappoo Cut. Improving Wappoo Cut, South Carolina, ten thousand dollars.

Neabsco Creek. Improving Neabsco Creek, Virginia, five thousand dollars.

Bayou Bartholomew. Improving Bayou Bartholomew, Louisiana and Arkansas, eight thousand dollars.

Tensas River. Improving Tensas River, Louisiana, three thousand dollars.

Bayou Black. Improving Bayou Black, in Louisiana, ten thousand dollars.

Bayou Boeuf. Improving Bayou Boeuf, Louisiana, five thousand dollars.

Current River. Improving Current River, Missouri and Arkansas, from Doniphan to its mouth, two thousand dollars.

Rancocas River. Improving Rancocas River, New Jersey, ten thousand dollars.

Christiana River.

Improving Christiana River and Wilmington Harbor, Delaware: Deepening the channel and improving the harbor of Christiana River from the Delaware River to and above the city of Wilmington, in accordance with the surveys and plans of the United States Engineer Department, fifty thousand dollars.

Chester Creek.

Improving Chester Creek, Pennsylvania, three thousand dollars.

Mattawan Creek.

Improving Mattawan Creek, New Jersey, fifteen thousand dollars.

Raritan Bay.

Improving Raritan Bay, New Jersey, from Perth Amboy and South Amboy to the main ship-channel off Great Kiln, fifty thousand dollars.

Newport Harbor.

Improving Newport Harbor, Rhode Island, twenty-five thousand dollars.

Tradewater River.

Improving Tradewater River, Kentucky, open navigation, three thousand dollars.

Cumberland River.

Improving Cumberland River, Kentucky, above mouth of Jelico, ten thousand dollars.

Buffalo Bayou.

Improving Buffalo Bayou, Texas: To secure a channel of one hundred feet, twenty-five thousand dollars.

Kewanee Harbor.

Improving Kewanee Harbor, Wisconsin, five thousand dollars.

Niagara River.

Improving Niagara River, New York, five thousand dollars.

Portland Harbor.

Improving Portland Harbor, Maine, twenty thousand dollars.

Scituate Harbor.

Improving Scituate Harbor, Massachusetts, ten thousand dollars.

Moosabec Bar.

Improving Moosabec Bar at Jonesport, Maine, ten thousand dollars.

Wareham Harbor.

Improving Wareham Harbor, Massachusetts, ten thousand dollars.

Canarsie Bay.

Improving Canarsie Bay, New York, five thousand dollars.

Sheepshead Bay.

Improving Sheepshead Bay, New York, five thousand dollars.

Salem River.

Improving Salem River, New Jersey, three thousand dollars.

Susquehanna River.

Improving Susquehanna River, Pennsylvania, above Richards' Island, fifteen thousand dollars.

Improving Susquehanna River above and below Havre de Grace, Maryland, fifteen thousand dollars.

Archer's Hope River.

Improving Archer's Hope River, Virginia, five thousand dollars.

Wateree River.

Improving Wateree River, South Carolina, eight thousand dollars.

Santee River.

Improving Santee River, South Carolina, by deepening and straightening its outlet to Winyah Bay through Mosquito Creek, twenty-two thousand dollars.

Pensacola Harbor.

Improving Pensacola Harbor, Florida, twenty thousand dollars.

Tchefuncte River.

Improving Tchefuncte River, Louisiana, one thousand five hundred dollars.

Tickfaw River.

Improving Tickfaw River, Louisiana, two thousand dollars.

Bayou Teche.

Improving Bayou Teche by connecting same with Grand Lake at Charenton, Louisiana, twenty-five thousand dollars.

Brazos Harbor.

Improving bar and harbor at Brazos Santiago, Texas, seventy-five thousand dollars.

Yallabusha River.

Improving Yallabusha River, Mississippi, three thousand five hundred dollars.

Tchula Lake.

Improving Tchula Lake, Mississippi, three thousand dollars.

Louisville and Portland Canal.

For the expenses of operating and maintaining the Louisville and Portland Canal for the fiscal year ending June thirtieth, eighteen hundred and eighty-one, forty-two thousand dollars, which sum shall be immediately available.

Yaquina Bay.

Improving entrance to Yaquina Bay, Oregon, ten thousand dollars.

Cowlitz River.

Improving Cowlitz River, Washington Territory, one thousand dollars.

Pier at Donaldsonville, removal of

Of the amount now available for the improvement of Bayou La Fourche, Louisiana, the sum of five hundred dollars, or so much thereof as may be necessary, shall be expended in the removal of brick pier at Donaldsonville.

Richmond Harbor, Kennebec River.

Improving Richmond Harbor, Kennebec River, Maine, ten thousand dollars; of which sum six thousand dollars shall be expended for wing-dams and dredging at the head of Swan's Island and at Hatch's Rock, and four thousand dollars in dredging and deepening the channel at the foot of Swan's Island according to the plan recommended by Lieutenant Russell.

Reservoirs upon headwaters of Mississippi River.

Proviso.

Damages to private property, compensated for under State laws.

For reservoirs upon the headwaters of the Mississippi River and its tributaries, one hundred and fifty thousand dollars; and this sum, together with the sum of seventy five thousand dollars heretofore appropriated for the construction of a dam at Lake Winnibigoshish, shall be expended at such places on said headwaters of the Mississippi River and its tributaries as the Secretary of War shall determine: *And it is provided*, That compensation for any private property taken or appropriated for any of said improvements, and all damages to private property caused by the construction of any of said dams, by flowage or otherwise, shall be ascertained and determined under and in accordance with the laws of the State in which such private property is situated.

Rights of Indians preserved and protected.

Proviso.

And the Secretary of the Interior is hereby authorized and directed to ascertain what, if any, injury is occasioned to the rights of any friendly Indians, occupying any Indian reservation, by the construction of any of said dams, or the cutting or the removing of trees or other materials from any such reservation for the construction or erection of any of said dams, and to determine the amount of damages payable to such Indians therefor; and all such damages to private property and to friendly Indians, when ascertained and determined in the manner herein directed and provided, shall be paid by the United States: *Provided, however*, That such damages shall not exceed ten per centum of the sums hereby and heretofore appropriated for the construction of said reservoirs.

Sumpawamus inlet.

Improving Sumpawamus Inlet, New York, five thousand dollars.

Saint Jerome's Creek Harbor.

Improving the harbor at the entrance of Saint Jerome's Creek, Maryland, six thousand five hundred dollars.

Saint Jones River.

For the improvement of Saint Jones River, in the State of Delaware, five thousand dollars.

Purchase of sites for locks and dams.

Proviso.

Proviso.

Title, how perfected.

Manner of making improvements.

Proposals.

Contracts after advertisement.

Lowest bidder.

Such parts of the money appropriated by this act for any particular improvement requiring locks and dams as may be necessary in the prosecution of such improvement may be expended in the purchase, voluntary or by condemnation, as the case may be, of necessary sites: *Provided*, That such expenditure shall be under the direction of the Secretary of War: *And provided further*, That if the owners of such lands shall refuse to sell them at reasonable prices, then the prices to be paid shall be determined and the title and jurisdiction procured in the manner prescribed by the laws of the State in which such lands or sites are situated. It shall be the duty of the Secretary of War to apply the money herein appropriated for improvements, other than surveys and estimates, in carrying on the various works, as far as can be without actual detriment to the interest of the government, by contract. Where such works cannot be done by contract without injury to the public interest, they may be prosecuted by hired labor. Where said works are done by contract, such contract shall be made after sufficient public advertisement for proposals, in such manner and form as the Secretary of War shall prescribe; and such contracts shall be made with the lowest responsible bidders, accompanied by such securities as the Secretary of War shall require, conditioned for the faithful prosecution of the work according to such contract, and for the proper payment of all liabilities incurred in the prosecution thereof for labor and material

1868, Res. 69. Stat., 15, 258. Amended.

Bridge across the Mississippi at Rock Island.

Chicago, Rock Island and Pacific Railroad Company.

Rates of freight per car.

SEC. 2. That the joint resolution approved July twentieth, eighteen hundred and sixty-eight, authorizing the construction of the bridge over the Mississippi River "to connect the island of Rock Island with the cities of Davenport and Rock Island", is hereby so amended as to require the Chicago, Rock Island and Pacific Railroad Company to charge for any cars carrying freight other than those passing over its own road, and for its own cars when carrying freight for other roads, which it may carry across said bridge, a sum not exceeding three dollars for every loaded car, two-fifths of which sums shall be paid by said railroad company into the Treasury of the United States each month; and the monthly returns thus made shall be in such form, and with such authentication, as the Secretary of War shall direct.

Examinations and surveys.

SEC 3. That the Secretary of War is hereby directed, at his discretion, to cause examinations or surveys, or both, and estimates of cost of improvements proper, to be made at the following points, namely:

Harbor of San Luis Obispo, California.

Tombigbee River, Mississippi, from Fulton to Warren's Mill.

The Chattahoochee River, in Georgia, between West Point and Bolton, on the Western and Atlantic Railroad, so as to complete the survey of that portion of said river.

Bear Creek, running into Yazoo River.

Harbor at Port Henry, on Lake Champlain.

Frankford Creek from its mouth in the Delaware River to Frankford Avenue.

Five Mile Point, above Bridesburg, Delaware River.

Mouth of the Mispillion, Delaware.

Mokelumne River, California, from its mouth at or near Woodbridge.

New York Bay between Sandy Hook and Coney Island Point.

Newton Creek, Camden County, from Delaware River to head of navigation.

Mantua Creek, Gloucester County, from Delaware River to head of navigation.

Maurice River from Delaware Bay to Millville, Cumberland County.

Salem and Cohansey Rivers, New Jersey.

Completing survey of Harlem River and through the Harlem Kilns to the East River.

Survey for harbor of refuge in Lake Pepin, at Stockholm, Wisconsin, and Lake City, Minnesota.

Beaver Bay, Minnesota, to ascertain the cost and practicability of making it a harbor of refuge.

Grand Portage Bay and Wans-wau-goising Bay, Minnesota, to determine which, if either, should be made a harbor of refuge.

Sackett's Harbor, New York.

Matagorda Bay at the mouth of Saint Mary's Bayou, near the town of Matagorda, Texas.

Harbors of Madison and Clinton, Connecticut.

Edgartown Harbor and South Beach, Massachusetts.

Staunton River from Brook Neal, in Campbell County, to mouth of Pig River, Virginia.

Roanoke River from Weldon North Carolina, to Clarksville, Virginia.

Bear Creek, running from Northeast Mississippi into the Tennessee River.

To deepen the channel of the Harrisecket River from Weston's Point to Freeport Landing in Freeport, Maine.

The channel of Broad Creek on the west side of Kent Island, Maryland.

Harbor of Brunswick, on the Androscoggin River.

Buzzard's Bay and Barnstable Bay, Massachusetts, at the entrance of the proposed Cape Cod Canal.

Sabine Pass, Texas, through Sabine Lake and River to Orange and Sabine Lake, and the Neches River to Beaumont, to ascertain the cost and practicability of a deep-water channel from Sabine Pass to Orange and Beaumont.

Old Town Creek, Mississippi.

Bar at mouth of Winyah Bay, near Georgetown, South Carolina.

Little Red River in Arkansas.

And the Secretary of War is hereby directed to cause to be made examinations and surveys, or both, and estimates of the cost of the further improvements necessary to be made in the Savannah River and Harbor to increase the depth of the water in said river and harbor from the bar up to the city to twenty-two feet, and to make an estimate of the cost of widening the channel of the Savannah River opposite the city to six hundred feet of uniform depth with the balance of the channel.

Young's, Lewis' and Clarke's, and Skipanon Rivers, entering into Young's Bay, in the county of Clatsop, near mouth of Columbia River, Oregon.

Snake River from Lewiston to the mouth of Salmon River, Idaho Territory.

Corsica Creek, Maryland.

Harbor at mouth of Cedar River, on Green Bay, Michigan.

Lynn Harbor, Massachusetts.

Merrimac River from Lawrence, Massachusetts, to Manchester, New Hampshire.

Channel between islands of North Hero and South Hero, Lake Champlain.

Little Tennessee River from its mouth on the Holston or Big Tennessee River to the mouth of Tellico River.

Dog Island Harbor, harbor of Key West, Crystal River, La Grange Bayou up to Freeport, Manatee River, and Crooked River, Florida.

Indian River, Florida, at the north end, in view of opening a passage into the lagoon one-half mile east.

From a point between Ellis Island and the docks of New Jersey Central Railroad to a point between Robbins' Reef Light and Constable Hook, in waters of New York Bay, New Jersey.

Big Black River, Mississippi.

Outlet of harbor of Ship Island.

Harbor at Boloxi, Mississippi.

Harbor at Pascagoula, Mississippi.

Upper thoroughfare leading into Tangier Sound, Deil's Island, and Rock Creek, Maryland.

Fish Bend, near Fort Chartres, in the Mississippi River.

Murder Kiln, Delaware.

Delaware River.

Potomac and Anacostia Rivers, in the vicinity of Washington, District of Columbia, with reference to the improvement of navigation, the establishment of the harbor-line, and the raising of the flats, so far as their improvement may be necessary to the improvement of navigation and the establishment of the harbor-line.

Mouth of Cedar River, Green Bay, Michigan.

Greenport Harbor, New York.

Survey for harbor of refuge at New Buffalo, Michigan.

The headwaters of the Cannon River, in Minnesota, with a view that the same may be added to the reservoir system of the Upper Mississippi.

The water connection between the Waccamaw and Cape Fear Rivers, with the view of ascertaining if a continuous inland water connection cannot thereby be established.

Toledo, Ohio, for a straight channel to Lake Erie.

For harbor at Caseville, Saginaw Bay, Lake Huron.

The Calumet River from South Chicago to the village of Pullman, on Lake Calumet.

For a further survey of James River, for the purpose of ascertaining the practicability and cost of procuring a channel of twenty-five feet at full tide from Richmond to the mouth of the river

Survey of Upper Machodoc Creek, a tributary of Potomac River.

Survey of Urbana Creek, a tributary of Rappahannock River, from the village of Urbana to the Oaks.

The harbor of Mamaroneck, New York.

Cumberland River at Smith's Shoals, in the State of Kentucky, to ascertain the practicability and the cost of a canal, with locks and dams, from the head to the foot of said shoals.

The harbor at the Delaware Breakwater, and the entrance thereto.

Indian River, in the State of Delaware, from its mouth to Millsborough.

Survey of the Clarion River from its mouth to Ridgway, Pennsylvania.

From Brazos de Santiago through Laguna Madre to Point Isabel, Texas, to ascertain the cost and practicability of a deep-water channel from the anchorage at Brazos de Santiago to the railroad wharf at Point Isabel.

Survey for breakwater and harbor of refuge at Milford Connecticut.

Entrance to Gray's Harbor, Washington Territory.

Between Baker's Bay and Shoalwater Bay, Washington Territory, for canal for light draught vessels.

Missouri River at or near Arrow Rock.

For survey of Nishnabotana from Hamburg, Iowa, to its junction with the Missouri.

Skipton Creek, Maryland.

Bush River, Maryland, from Harford Furnace to Chesapeake Bay.

Licking River from its mouth to Falmouth, in Kentucky.

Oregon Inlet, in Dare County, in North Carolina.

Survey of Chehalis River, in Washington Territory.

Whiteoak, Meherrin, and New Rivers, in North Carolina.

Appropriation. SEC. 4. That for the examinations and surveys herein provided for, and for incidental repairs of harbors for which there is no special appropriation, the sum of fifty thousand dollars is hereby appropriated out of any money in the Treasury not otherwise appropriated; and in every **Report.** case where examinations or surveys are made, the report thereon shall embrace such information concerning the commercial importance, present and prospective, of the improvement contemplated thereby, and such general commercial statistics as the Secretary of War may be able to procure.

Approved, March 3, 1881.

APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

FORTIFICATIONS, Etc.

APPENDIX No. 1.

SEA-WALL AT GOVERNOR'S ISLAND, NEW YORK HARBOR, IN CHARGE OF COLONEL H. W. BENHAM, CORPS OF ENGINEERS.

EXPLANATION OF THE ESTIMATE.

Extracts from letter from Maj. Gen. W. S. Hancock, commanding Military Division of the Atlantic, to the Adjutant-General United States Army, dated August 20, 1878.

SIR: I have the honor to recommend a suitable appropriation for the completion of sea-wall around Governor's Island. Colonel Benham, the Engineer officer in charge, has, I am informed, made estimates for the purpose. I cannot too strongly urge the necessity for the early prosecution and completion of this important work. Governor's Island is within the greatest city of this continent, New York, and in immediate proximity to the great city of Brooklyn; and on these, as well as on the sanitary grounds fully set forth in the within communication, to which I invite special attention, its bounds should be permanently fixed by a suitable sea-wall. The shore between high and low tides is shelving and interspersed with rocks, which serve to retain at the fall of the tide the refuse brought up at high-water. As an illustration of the evil from this source, I would state that official reports of observations carefully made in the six months from July, 1873, to January, 1874, show that the following carcasses of dead animals floating in the bay were thrown upon the island during that period, viz: July, 1873, 369; August, 1873, 205; September, 1873, 121; October, 1873, 58; November, 1873, 75; December, 1873, 75; total for six months of 1873, 903.

Although these carcasses are offensive and injurious, they are probably not so dangerous to health as the clothing, bedding, &c., infected with disease, thrown upon the shore of the island by the tide, and which lodges for want of a sea-wall. Yellow fever on the island was, in one instance at least, traced directly to the latter cause.

* * * * * * *

It is true that the management of the general police of the harbor by the city is not so bad now as it was during the time to which the statistics above given relate, but still, although in a somewhat smaller degree, the nuisance remains, and can only be properly dealt with, for this island, through the aid of a sea-wall.

* * * * * * *

Hoping the subject may receive the favorable consideration of the War Department and Congress, I am, sir,

Very respectfully, your obedient servant,

WINFIELD S. HANCOCK,
Major-General, Commanding.

Indorsement by commanding officer at Fort Columbus, dated August 8, 1878, *on report by Assistant Surgeon J. P. Kimball on sanitary condition of the post, the substance of which is stated in the above extracts from General Hancock's letter; and indorsement of Surgeon and Medical Director J. M. Cuyler, U. S. A.*

HEADQUARTERS FORT COLUMBUS,
August, 8, 1878.

The facts stated by Assistant Surgeon Kimball are well known to any one who has resided on Governor's Island for any length of time. The sanitary condition of this island will never be good until its shores are protected from filth by a suitable sea-wall, and with the view of bringing this subject to the notice of the commanding general this report is respectfully referred to department headquarters.

J. P. SANGER,
Captain, First Artillery,
Commanding Post.

HEADQUARTERS DIVISION ATLANTIC
AND DEPARTMENT EAST,
MEDICAL DIRECTOR'S OFFICE,
Governor's Island, New York Harbor, August 13, 1878.

As a sanitary measure, the completion of the sea-wall around the entire island is unquestionably of the greatest importance, and I most earnestly recommend that the work be done at as early a period as possible.

JNO. M. CUYLER,
Colonel and Surgeon, U. S. A.,
Medical Director.

Extract from annual report of Col. H. W. Benham, Corps of Engineers, dated July 11, 1878.

* * * * * * *

I would also respectfully represent the condition of the shores and shoals upon the southeast part of this island, back of the range of officers' quarters, between the South Battery and the main wharves.

The shore line along the reach named is without protection, and is irregularly broken down by the wash of the waves in storms, while in front, or outward from the shore, a shoal extends, bare at low-water, to the distance of 100 to 200 feet, which, from its position in the eddy between the Buttermilk Channel and the Hudson River, receives the drift and carrion offal of the river, making it often very offensive to the residents on the island.

The best remedy for this, and a necessity, I consider to be a sea-wall, of rounded or convex line of short faces running out upon this shoal, which, without indentations, would give a regular current and direction to the water, thus tending to carry off all such offensive matter, while the space in rear, filled up as it might be without great cost, in part perhaps by the garrison, would add some acres to the area of the island where every yard of land is so valuable.

* * * * * * *

Very respectfully, your obedient servant,

H. W. BENHAM,
Brevet Major-General,
Colonel of Engineers.

REPORT ON THE CONSTRUCTION OF A SEA-WALL AROUND GOVERNOR'S ISLAND, NEW YORK HARBOR, BY LIEUT. EUGENE GRIFFIN, CORPS OF ENGINEERS, DATED JANUARY 26, 1880.

GOVERNOR'S ISLAND,
New York Harbor, January 26, 1880.

SIR: In accordance with instructions from these headquarters, I have the honor to submit the following report upon the construction of a sea-wall around this island.

The necessity of this wall has already been settled in the affirmative. It is not for the benefit of Governor's Island alone; the cities of New York and Brooklyn are also largely interested. The island does not lay so far from either as to render them safe from any contagious disease which may rage thereon. That they escaped from the epidemics of 1856 and 1870 is true, but that they would again be as fortunate is extremely problematical.

The object to be attained by the wall must, of course, influence its location and construction, and therefore requires careful consideration.

Its construction is necessary, principally, as a sanitary measure, for the following reasons:

During the summer months, on account of its exposed position, Governor's Island is subject to epidemics and diseases from several exterior causes. In a report on the sanitary condition of the island made by Assistant Surgeon J. P. Kimball, U. S. A., to the medical director of this division, June 26, 1879, he argues that the yellow-fever epidemics of 1856 and 1870, which caused such suffering on this island and which did not extend to New York City, were due, wholly or in part, to the proximity of the Atlantic Docks in Brooklyn, where, as a general rule, vessels from infected ports were discharged either directly or by lighters. The exposed flats on the southeast of the island are an excellent place of lodgment for the germs of this disease, which might easily be wafted across the narrow Buttermilk Channel. Doctor Kimball thinks it highly probable that this was the manner in which the fever was introduced; it originated and raged with the greatest severity among the families residing on this portion of the island. That this may occur again is more than likely, and the only effectual preventive would seem to be a sea-wall at or beyond low-water mark, so as to afford no foothold to this terrible scourge.

Again, diseases and disorders are generated by the putrefying bodies of animals left stranded on the shores of the island by the receding tide. The reports of the commander of Fort Columbus show that during the months of May, June, July, August, and September, 1879, the following enormous aggregate was reached: 1,221 dead animals and pieces of carrion, 3 corpses—2 men and 1 infant; and that, in addition, 73 bedsacks, pillows, blankets, &c., were found on the shores and burned, the latter perhaps being even more injurious than the animals. The deleterious effect of this frightful showing can be easily imagined. Unceasing vigilance on the part of the island police alone prevents the more dire results.

The post commander indicates four points as particularly liable to these visitations, viz: Directly south of and adjoining the coal-dock, near the post hospital, just south of Castle Williams, and the strip of beach between the engineer boat-house and the arsenal. The results of my own observations agree with this, and these points are where eddies exist, and such results would consequently be expected, due to the direction of the currents. The proper remedy for this evil is evidently a sea-wall at or near the low-water line.

Due to the proximity of the large cities of New York and Brooklyn, and the immense amount of filth and refuse hourly passing from them to the waters of the bay, these waters are carried past the island saturated with organic matter.

At low-tide the exposed flats are covered with this, and decay results at once from the powerful effect of the summer sun. At present this evil is unavoidable. These flats should evidently be excluded from the action of the water.

This brief *résumé* shows that, as a sanitary measure, it is of prime importance that the wall be built at, or as near as possible to, the low-water line.

Detached portions of walls are already constructed as follows: From the stone wharf a straight reach of 607 feet towards the northwest, thence 300 feet towards Castle Williams, terminated at this point by a wall running at right angles some 39 feet to the bank. This wall is between the high and low-water lines. Around Castle Williams there are 354 feet of wall completed, built at the low-water line. This was probably built at the same date as the castle itself, but is in good condition.

Between the castle and the post hospital (the old isolation ward used temporarily as a post hospital) there are three reaches of 259, 551, and 204 feet, respectively, but this wall is but partially completed, is above the high-water line, and is therefore of little value. From the hospital towards the South Battery there are two reaches of 272 and 458 feet, respectively, in nearly a right line, just above mean low-water, and from the extremity of the last line a partially completed wall, 135 feet in length, extends in a curve around the South Battery. This wall was built in 1866–'67.

To recapitulate, there are 1,991 feet of sea-wall completed, in proper position, and in good condition; there are 39 feet in like condition, but of no value should the wall be extended; finally, there 1,149 feet partially completed, in a useless position, and of no value to the general plan, except so far as it may furnish material. These walls are all built of several courses of granite blocks, about one and a half feet in thickness, and of varying length, backed with concrete, and having a coping of dressed stone three feet in width

It is not considered that this report is to fix any line of wall, but simply to recommend an approximate line, suitable to accomplish the desired results, and to give general data bearing on the subject. I have considered it simply from a sanitary point of view. The wall will probably be built under the direction of an engineer officer, and as Governor's Island is a fortified position, and part of the interior line of defense of New York Harbor, other considerations may come in to modify the proposed line, and more detailed data than I have had the time to obtain will be used to fix the final location.

I have based my recommendations on careful consideration of all available data and personal knowledge of the local peculiarities, derived from several months' work on a survey of the island; and the proposed line, and reclaimed land consequent thereon, will not only be detrimental to the commercial interests of the harbor, by injuring the channels, but will, I think, be a positive benefit by increasing (slightly to be sure) the scour which has made Buttermilk Channel a commercial highway where formerly cows could pass at low-water.

Governor's Island lies directly in the track of the East River, at its mouth, so to speak. The powerful current from this river at ebb tide, broken somewhat by Diamond Reef, strikes the northeast point of the island, divides, and swells the current of the Hudson or North River on the west, and sweeps through Buttermilk Channel on the east; the latter portion is deflected by the shore line and the docks towards the Atlantic Basin and docks on the Brooklyn side, which in turn deflect it westward. (The directions of the currents are shown on the accompanying map marked A.* The rapid shoaling south of the entrance to the Atlantic Basin is due to the westward deflection of the current by the dock above.) The flood current has a very peculiar direction around the shores of the island. Setting directly upon the wall around Castle Williams from an almost northerly direction, it divides and flows gently along the west and northeast shores; the first or west current follows the line of the shore to the South Battery, and then continues on directly towards Brooklyn until near the buoy, when it turns up the East River; the second current continues to follow the shore to the docks.

Between the docks and the South Battery the waters are thus undisturbed at all stages of the tide, and the shoal along this line is the natural result. The swift current of Buttermilk Channel would soon wear this shoal away if it lay within the sphere of its action.

The conditions governing these currents are nearly permanent; the farther works at Diamond Reef will not be of such extent as to produce any material effect, and there is no reason to suppose that any shoaling will take place along the line of the Brooklyn docks necessitating their further extension. The sea-wall, then, should be made to follow approximately the bottom contours, from the docks to the South Battery, in order to obtain a state of permanence, and to produce no effect, or as little as possible, on the tide-way and surrounding shores, a result, of course, desirable to obtain. All re-entering angles, however, should be strictly avoided, and all salient angles made as obtuse as possible. A re-entering angle would only form a place of deposit, and in a short time an exposed beach would be the result. The amount of ground thus reclaimed, and consequent contraction of the water-way, would not affect the currents to any appreciable extent. As before stated, this portion of the water-way lies beyond the action of the current, and the waters at this point are always more or less quiescent.

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* The maps are not printed.

The North and East Rivers unite southwest of the island, and, as would be expected, a shoal extends to this point. The wall by the hospital should be extended 142 feet in the same direction, and from thence directly to the castle, thus bringing it at about low-water.

On the north, if the wall now completed in the ordnance grounds be extended 301 feet on the same line, thence 510 feet towards the castle dock, and thence to the boat-house and shore, the action of the current will keep the small amount of exposed land clear. A short wall, 79 feet in length, will be necessary to connect the castle wall with the dock.

The wall, as thus completed, would extend around the entire island, except between the three docks, and for various reasons it may be desirable to have an exposed beach in these intervals. If, however, it is deemed advisable to complete the wall between the stone dock and the main dock, it may be done on the line indicated. (On the accompanying map marked B these additional walls will be found indicated by broken red lines, and located in accordance with the above recommendations.) Their lengths are as follows: From the arsenal to the castle, 1,092 feet; from the castle to the hospital, 1,515 feet; from the South Battery to the docks, 1,766 feet; and between the docks, 138 feet; total, 4,511 feet. General H. W. Benham, Corps of Engineers, in his annual report to the Chief of Engineers for 1879, estimates for 1,800 feet of sea-wall in rear of the line of officers' quarters, at $20 per foot. Taking this estimate, the cost of the entire wall would be $90,220.

The amount of land reclaimed and added to the area of the island would be, between the docks and South Battery, about 4.3 acres; between the hospital and Castle Williams, 2.1 acres; between the castle and the arsenal, 1.4 acres; and between the docks, 0.2 acre; making a total of about 8 acres, an increase of about ⅛ in the area of the island. It is impossible to accurately estimate the value of this land, but from the position of Governor's Island it is evident that every acre gained in this way, without detriment to the commercial interests, is extremely valuable. Over half this amount, it will be noticed, is gained between the docks and the South Battery. This land would be of no direct use for the erection of military defenses for the harbor, but would be extremely valuable for the erection of shops and other buildings, which might otherwise encroach upon the defensive lines of the island.

To fill in this area to a proper level would require a mean depth of about five or six feet, and this would require sixty or seventy thousand cubic yards of material. The west side might be filled entirely by cutting the bank down to the level of the wall, and doubtless a vast amount of material might be obtained at no expense that is now dumped beyond the Narrows. The amount of filling in, and the question of obtaining material therefor, are serious considerations, and, with others mentioned before, may make certain changes in the location of the wall desirable, or even necessary.

I have not considered it necessary to connect the extremities of the wall by the coal and main docks with the shore. These docks are built of heavy crib-work, and would almost of themselves retain the filling and exclude the water sufficiently to prevent all outward wash. Heavy planking, however, would make them perfectly secure.

I would state, in concluding, that any changes which may be made in the location of the wall will not greatly affect its length, and on the basis of General Benham's estimate $90,000 will be the probable expense, though. as any change would probably tend to shorten the wall, this amount may be taken as the maximum limit.

Very respectfully, your obedient servant,

EUGENE GRIFFIN,
First Lieutenant of Engineers.

ASSISTANT ADJUTANT-GENERAL,
Headquarters Military Division of the Atlantic, Governor's Island.

[First indorsement.]

HEADQUARTERS MILITARY DIVISION OF THE ATLANTIC,
Governor's Island, N. Y. H., January 30, 1880.

Respectfully forwarded to the Adjutant-General of the Army.

The necessity for the early completion of the sea-wall around Governor's Island, with a view not only to the better preservation of the island itself and the health of its inhabitants, but to the general improvement of the harbor of New York and the sanitary condition of New York City and Brooklyn, has been heretofore represented by me to higher authority, especially in my report on the subject dated August 20, 1878. The project is also understood to have received the recommendation of the Engineer Bureau of the War Department and of the Secretary of War to Congress, and to have had already partial consideration by that body. The within report of First Lieut. Eugene Griffin, Corps of Engineers, with accompanying map, not only shows the importance of the subject in its general aspect, but also sets it forth in detail, and it is commended to the attention and consideration of higher authority in connection with the papers previously submitted.

If any information in addition to that contained in the within report and in previous reports is deemed necessary, I shall be glad to furnish it, if practicable, and trust that the matter may receive early consideration.

W. S. HANCOCK,
Major-General, Commanding.

APPENDIX No. 2.

LETTER FROM LIEUT. COL. Q. A. GILLMORE, CORPS OF ENGINEERS, TO THE CHIEF OF ENGINEERS, RESPECTING THE PRESENT CONDITION OF OUR SEA-COAST DEFENSES, AND THE IMPORTANCE OF STRENGTHENING THEM.

NEW YORK, *July* 15, 1881.

GENERAL: My annual report upon the harbor defenses in my charge, occupying the Atlantic sea-board from New York to Florida, is herewith submitted.

I am constrained by a somewhat intimate knowledge of the notable weakness of these defenses to offer the following notes and suggestions upon the problem of sea-coast defense presented for solution at the present day.

AN UNPROTECTED SEA-COAST.

The published records of our War Department for the last dozen years show with great force and clearness that we not only possess no guns capable of making a good defense against a modern fleet, but that if we had the guns we have no places in readiness to receive them where they could be effectively served against armored vessels firing small missiles and case-shot at suitable ranges.

In other words, before we can hope to repel the attacks of war vessels of recent type, not only will the artillery for our forts have to be procured, but the forts themselves will need to be built, or the existing forts greatly modified.

This statement is so entirely true with respect to the most valuable of our positions on the sea-board, that they may very properly be regarded as wholly destitute of protection, that which has been provided for them by the stringent economies of Congress being of little, if any, account.

It is true that we have on hand at our forts and arsenals a number of old mortars and rifled and smooth-bore guns of obsolete models and insufficient calibers, and the best of them could soon be put in readiness for such doubtful service as they might be able to render in our barbette batteries, where both guns and gunners are in full view, exposed to direct and curved fire. Whether they could be served at all, even for a brief period, in these exposed positions, against vessels showering grape, canister, and case-shot from large guns, and leaden bullets from machine guns and other rifles, would be a question of the greatest import, were the guns themselves of the requisite power. They are known, however, to be so entirely unfit for the work they would have to do as to render it in great measure immaterial whether they could be served or not. It is not, however, altogether immaterial, for these small calibers would be useful against wooden vessels and some of the old thin-plated iron-clads. They would be of some value in defending shallow harbors accessible to vessels of light draught only, belonging to either of these two classes.

It thus happens, since we have a partial supply of small guns and no large ones, that we can make a better defense of our shallow and less valuable harbors than we can of those having deep and capacious channels of approach. New York, Newport, Boston, and harbors of that class are practically defenseless, while Charleston, Savannah, and Fernandina could be made reasonably secure on a few months' notice. Indeed, our ability to protect varies inversely with the importance of the localities requiring protection. But when the best has been said in our behalf, we must still confess that our metal is altogether too light, that our projectiles would strike harmless against modern naval armor, and that any approach to an effective defense at points where defense is most needed and most demanded would be simply out of the question. We would be wholly at the mercy of a few armored or iron-clad vessels.

New inventions in gun-making, in armor-clad ship-building, and in the use of explosives in submarine warfare, have revolutionized, and in a large measure superseded, the former methods and conditions of harbor defense.

It is an error to suppose that the channels leading into our most valuable harbors are too shallow to admit a modern fleet.

Depth of draught is not a measure of offensive power, and never can be. The most powerful batteries are carried on a moderate draught of water. The English turret cruisers Inflexible, Agamemnon, and Ajax, armed with 38-ton and 81-ton guns, throwing projectiles of 700 to 1,700 pounds weight, draw but 25 feet when fully equipped and ready for sea, and high naval authority asserts that armored cruisers of a very formidable type, capable of navigating the ocean with safety and dispatch, can be built on a service draught of 23 to 24 feet. Moreover, the practice of naval construction at the present time unmistakably tends to light-draught vessels, thus destroying that partial security against armored fleets which all our comparatively shallow harbors were formerly, and very properly, thought to possess.

It seems improbable that many such unwieldy monsters as the 4-gun turret ship Dreadnaught and the 12-gun broadside ship Alexandria, which, together, cost the English Government over $5,000,000 exclusive of armament and outfit, will be built in future.

Disregarding, however, any additional danger to ourselves from vessels of lighter draught than those now afloat, there are among the present armored fleets of Europe only ten cruisers drawing more than 27 feet of water, and only three drawing more than 28 feet, while there are more than half a hundred drawing 24 feet or less.

There are more than a dozen fine harbors on our Atlantic coast—Portland, Portsmouth, Boston, Newport, and Hampton Roads being among the number—easily accessible to the largest war vessels hitherto constructed or contemplated.

There are more than half a dozen other harbors, among which may be specified New Bedford, New London, New York, and Key West, into which a few of the deepest draught men-of-war cannot enter. But there is not one of them that does not possess ample depth to pass half the armored cruisers of Great Britain, including vessels armed with the 38-ton and 81-ton guns; all the German armored vessels except one; more than two-thirds of those of the Italian navy; all belonging to the Russian navy except two; all belonging to the Austrian navy except three; all belonging to Holland and Turkey without exception, and a large portion of those belonging to the French and Spanish navies.

The aggregate population clustered closely about these twenty harbors for armored vessels is nearly 3,000,000, while the value of public and private property exposed within easy and destructive range of a hostile fleet cannot be far short of $2,000,000,000. The losses that might be inflicted upon these communities in a few hours, in their present unprotected condition, would exceed more than tenfold the entire cost of suitable permanent defenses for the whole country.

No account is here taken of that incalculable and far greater injury which would be entailed by even the brief presence of a victorious hostile fleet in our waters, keeping the whole coast in alarm, and deranging and destroying the business and industry of the people.

There is yet another numerous class of harbors, with still shallower channels of entrance, into which a draught of 22 to 24 feet can be safely carried, many of them being the centers of extensive commercial and manufacturing interests, which are exposed to the attacks of the lighter draught iron-clad cruisers.

It appears, therefore, that our entire Atlantic and Gulf coasts from Maine to Texas, a distance of more than 3,000 miles, is peculiarly at the mercy of a hostile naval power, and that our largest centers of population, commerce, and manufactures, where the greatest values are accumulated, and hence where the greatest temptations are offered and the greatest injury could be inflicted in the briefest interval of time, are within easy reach of the most destructive engines of war born of modern invention and science. The condition of the Pacific coast is equally defenseless.

The early completion of suitable harbor defenses would, therefore, seem to be an object of pressing importance. "Peace is the dream of philosophers, but war is the history of man." National weakness and national danger are interchangeable terms. Indeed, immunity from insult, whether among nations or among men, is largely determined by the ability to resent and avenge it.

The harbor defenses should be not only suitable with respect to efficiency, but reasonable with respect to cost. And they should, as far as possible, anticipate improved means of attack, and be susceptible of ready and inexpensive adaptation to them, to the end that costly preparations of every kind, whether afloat or ashore, that may now be deemed ample and appropriate, may not at an early day have to be laid aside as worthless or inadequate.

It is presumed that no one will doubt the wisdom of affording protection to the great interests thus placed in jeopardy. The question is, what method of protection shall be adopted?

CHARACTER OF THE ATTACK—REQUIREMENTS OF A GOOD DEFENSE.

The attack would be made by a fleet of armored and other steamers, armed with heavy guns, and equipped with offensive torpedoes and rams, the main object being to destroy our naval establishments, our cities and large towns, or to levy contributions upon them, and, in special cases, as subsidiary thereto, to effect temporary lodgments in one or more good harbors, and maintain them by naval superiority during the war as a basis for predatory naval expeditions.

The elements of national defense constituting a connected system are (1) a regular army and militia; (2) permanent fortifications equipped for conducting submarine war; (3) a navy similarly equipped.

Each of these co-ordinate powers is capable of making, and may be relied upon to make, a perfect defense within its appropriate sphere.

Beyond that sphere, being either impracticable or inefficient, it would be comparatively worthless.

The requirements of a good defense are determined by the character and magnitude of the attack. This is especially the case in artillery combats between shore batteries and fleets, or between fleets only. If an enemy brings heavy cannon against us, we must protect our guns from heavy shot, or they will soon be destroyed. And if his vessels also carry thick defensive armor, we are forced to use heavy projectiles against it or our defense is worthless, for where a large gun is needed to deliver a crushing blow, no possible accumulations of smaller guns will answer instead. Cumulative force implies unity of mass and impact. A thousand pounds of grapeshot, even if fired as one volley, can be stopped by a 1-inch steel plate, but if sent as a single bolt it will shatter the best 12-inch armor.

Having the heavy guns so mounted as to be suitably protected from destruction by the enemy's fire, let us add another condition, that those guns shall have time to do their proper work, that is, that the hostile fleet cannot run past them without stopping, but will be arrested by torpedoes or some other channel obstruction, and we have the whole theory and practice of modern harbor defense by fortifications and their accessories.

The remarks which follow are intended to show not only that this method of defense, supplemented in certain cases and at important localities by auxiliary naval power, is wholly trustworthy and practicable as well as comparatively inexpensive, but that no other method or system satisfies these conditions, or any one of them. Certain popular fallacies have found expression in a few of the public prints, and to some extent even upon the floors of Congress, which will be referred to in this discussion. For example, some would put their entire trust in an army, the militia of the country, against every kind of aggression; others regard an iron-clad navy as the only sure and safe defense; others still would place their whole dependence upon torpedoes in some form or another, and there are those who assert that nothing but hastily constructed earth-works are needed to repel a naval assault, maintaining that our late civil war settled the fact that these are better than fortifications of iron and stone.

These several points will be briefly discussed in their proper connection.

FUNCTIONS OF THE REGULAR ARMY AND MILITIA.

It seems quite unnecessary to state that no army, as such, no matter how well equipped it may be for active operations in the field, can take any part in repelling a naval attack, or exercise any influence on the issue thereof, because destitute of heavy artillery and the means of conducting submarine war, two requisite factors in such a contest. Its presence might, and doubtless would, swell the list of casualties, as would that of any other mass of interested but idle spectators of a conflict from which they were excluded, but no result useful to the defense could ensue therefrom.

If the enemy, however, attempted or succeeded in making a landing upon our coast, with a view of marching across any portion of the country, the duty of defense would fall upon the Army and Militia, and could be left there with entire confidence. We need not ask for a better guarantee of safety than the circumstance which gives opportunity for the enterprise, courage, and patriotism of our people to display themselves. Such a contingency is specially contemplated in our system, which, by providing local defense for channels of approach to important points, compels an enemy, as a condition of success, either to land beyond the reach of those defenses, or to attack them by his fleet. In the former case his forces would be confronted by the Army; in the latter, an army could make no resistance. The question is, in what way *can* resistance to a hostile fleet be best offered.

A good defense against a modern fleet requires a suitable array of heavy artillery, rams, and torpedoes, and trained men to manage and use them.

How shall this array be made most effective?

Shall the artillery be operated from forts or from vessels of war? If from forts, what shall be their character and strength? If from vessels of war, shall these constitute our main reliance, or be only one of the auxiliaries to a chief defense by forts?

As the answers to these questions contain the gist of the whole subject, they will bear some enlargement.

DEFENSE BY A HARBOR FLEET ALONE.

The idea that a navy, especially an "iron-clad navy," can furnish a sure defense, although both attractive and popular, finds no practical application among naval powers. Its soundness as a theory is freely admitted, because a harbor fleet, if as powerful as the enemy's, would be expected to make, and no doubt would make, a good defense. Every one at all familiar with the achievements of our Navy will cheerfully concede that point. But, at the very best, in that case our chances of victory would be only equal to those of the enemy, while the risks taken and the consequences to ensue from failure would be greatly unequal; for while the enemy could lose nothing but his fleet, we would lose not only our fleet, but those much more valuable possessions which the fleet was designed to protect. Where interests of great magnitude are at stake, ordinary prudence requires that as little as possible should be left to the caprices of chance. A safe and perfect defense of this kind implies, therefore, a harbor fleet somewhat more powerful than that of the enemy. It implies, also, that each point deemed worthy of protection, large and small alike, shall have a fleet as powerful as that required for the most important localities. Otherwise, lacking strength at all points except a few, our smaller navies, and the objects to whose defense they had been assigned, would be destroyed in detail. And finally, after having accomplished this work at his own time and pleasure, the enemy might, when confronted by an equal or superior force at our strongest positions, decline battle altogether, withdraw from our coast, and direct his efforts against our commerce upon the high seas, a commerce left entirely at his mercy by the policy which keeps the Navy in port for home defense. The enemy having left his own ports well defended by fortifications—a condition substantially true of all great maritime powers except the United States—would be free to adopt this course.

If it be contended that a proper naval defense can be made by seeking the enemy upon the ocean, or by shutting him up in his own ports, thus leaving our coast entirely defenseless—without either forts or vessels of war—the answer is that such an assumption is not only at variance with all the lessons of history, but is in itself intrinsically illogical and weak. The power to escape from or evade an enemy upon the high seas or break through a blockade, never very difficult of achievement, especially at night, even in the old time of sailing vessels, has been rendered comparatively easy and certain by the introduction of steam.

The chances of success, indeed, are in a direct ratio with the speed attainable, even admitting the speed of both parties to be the same, for the advantage in all such endeavors belongs to the party which takes the initiative. The history of ocean conflicts and cruises, of blockade-running and privateering, bears ample affirmative testimony on this point.

Moreover, under this method of defense, the weight of advantages would be with the enemy, and the weight of risks with us. Being equipped and embarked for a naval attack upon our coast, he could scarcely wish to encounter our fleet, constituting the only defense of that coast, under circumstances of brighter promise to himself than those offering upon the broad ocean, for he could then either engage us in battle, or withdraw under cover of night; and should he elect to withdraw, which would be the prudent course if inferior to us in strength, he could, at his option, or as might suit his purpose best, either retire under cover of his own fortified ports, or pursue and destroy our commerce on the high seas, or make a sudden descent upon our unprotected coast. Should he adopt the last-named course, he could even venture for this purpose to subdivide his fleet into small detachments, being certain of success at all points, because certain of finding our harbors unprotected by fortifications and our fleets absent upon the broad sea.

It would seem, therefore, that a cruising force, even if much more powerful than the enemy's, cannot be wisely relied upon for the defense of an extended sea-board.

These views are neither new nor novel. They are, moreover, believed to represent the matured judgment of the highest military and naval authorities, as they unquestionably do the practice of the great maritime powers of Europe, as embodied in their methods of sea-coast defense.

If they be substantially correct, as stated, a secure defense by naval means, although entirely practicable, requires not only that the Navy shall be permanently retained upon our coast, and within our harbors, but that its power at each point deemed worthy of protection shall somewhat exceed that of the single fleet which the enemy can bring against us. Not knowing where the enemy intends to strike, it would be necessary to be prepared for him at all points. If twelve armored vessels, properly equipped with torpedoes, be assumed as the limit of his offensive power, we must maintain more than a score of fleets, each more powerful than the enemy's twelve vessels, in order to defend even a few of our most valuable localities, and prevent their destruction or capture. And even upon this broad and costly basis, nearly one-half of our harbors for armored vessels and more than one-half of our entire Atlantic and Gulf coasts would be left entirely defenseless.

No estimate of the cost of such a method of defense will be made. Some idea of it may be gained from the fact that the single attacking fleet, if composed of the twelve British armed cruisers, drawing 26 feet and less, will have originally cost about $18,000,000 for hulls and machinery alone, exclusive of armament and outfit. (See Report of Chief Engineer J. W. King, U. S. N.)

Armored vessels of approved types cost nearly half a million of dollars per gun, while the same gun can be mounted on shore behind shot-proof shields, or iron scarps, for about one-eighth that sum.

The great first cost of vessels of war, their perishable nature, and the growing expense of preservation, repairs, and renewals, exclude a defense by naval means from more than a moment's consideration, except for those points—fortunately of rare occurrence—where adequate protection cannot be obtained by the cheaper method. Notwithstanding its excessive cost, however, it is necessary to resort to this method of defense where the channels of approach to bays, sounds, and other partially land-locked waters are too wide to be effectively covered by land batteries, if we would withhold these waters from use and occupation by the enemy. Long Island Sound and Delaware and Chesapeake Bays would have to be relinquished to a naval adversary unless held by naval means. Fortifications at suitable points, however, even in these isolated cases, are necessary auxiliaries to the defense by a fleet, in affording safe places of refuge for our mercantile marine, and points of rendezvous for our vessels of war before taking the offensive, or in case of disaster or defeat. But, in nearly every case, the channels leading to good harbors, to cities, large towns, and important establishments are sufficiently restricted in width to be effectively defended by shore batteries and their accessories.

Therefore, the important question is, can our main reliance against a naval attack be upon permanent fortifications aided by torpedoes?

DEFENSE BY FORTIFICATIONS AND THEIR ACCESSORIES.

Our existing sea-coast fortifications are an enlargement or outgrowth of the system begun soon after the war of 1812–'14. Although they have encountered, from time to time, some positive opposition and much non-professional skepticism, based upon their assumed or suspected inefficiency, or suggested by sentiments of rivalry, and have, on some occasions, been the subject of anxious inquiries on the part of the national Congress, their advocates have always been able to demonstrate the substantial advantages of the system, and vindicate the wisdom which inspired its adoption.

Their principal object, during the first quarter of the present century, was to close our harbors against a hostile fleet of wooden sailing vessels, largely at the mercy of winds and currents.

In the event of attack, the contest would partake somewhat of the nature of an artillery duel between the comparatively small guns of that period, arranged on the one side behind bulwarks of oak, and on the other behind walls of stone or brick. The odds were, therefore, greatly in favor of the latter, especially after shell guns and hot solid shot came into use. One gun on shore was found to be a match for several guns afloat. At all important points the guns were mounted in masonry casemates; in some cases in tiers, one above the other, and the gunners were protected from grape, canister, and leaden bullets by iron shutters hung in the embrasures. Booms and rafts for obstructing the channels were recognized as desirable accessories, to be adopted in special cases.

Although that system, in respect to the kinds and calibers of the artillery employed and the devices adopted for protecting guns and gunners, is now in great measure obsolete, and is, moreover, not especially the subject of the present discussion, it is proper to state that down to the period immediately preceding the outbreak of the civil war, it supplied all the elements, and satisfied all the requirements of a perfect defense. Wherever the works had been completed, or substantially so, they surpassed anything existing in Europe in the security which they afforded.

The adaptation of steam-power to the propulsion of vessels-of-war in the great speed, thorough control of movement, and independence of wind and current which it gave to the attack, whereby it became possible to pass through and get beyond the fire of the shore batteries in a comparatively brief space of time, seemed to place the defense at a disadvantage. But it was thought that the former preponderance would be fully restored by increasing the number of guns on shore, and by timber rafts and other floating obstructions, designed to be stretched and anchored in one or more flexible lines across the channel, and possessing sufficient weight, inertia, and strength of parts to resist the impact of the largest men-of-war. In extreme cases, the channel would be temporarily destroyed by sunken obstructions, such as wrecks, hulks, piles, cribs, &c., so as to be useless to both friend and foe.

Armor-plated vessels, which could with impunity remain under fire long enough to remove such obstructions, came next, and the superiority of the defense was again placed in jeopardy. But guns were soon made strong enough and large enough to destroy this armor. The iron plating was then made thicker only to be again destroyed by still larger guns; and thus the conflict, more experimental than hostile, between armor plating and armament went on until now the most powerful vessels are plated with 14, 16, 18, and 24 inches of metal, and rifled guns throw projectiles weighing from 700 to 1,700 pounds, with a muzzle velocity of 1,600 to 1,800 feet per second, and an energy ranging from 10,000 to 30,000 foot-tons. The 100-ton guns, of 17-inch bore, manufactured for the Italian navy by Sir William Armstrong, overtop even those high figures. Their projectiles, weighing 2,000 pounds, are thrown with a velocity of 1,500 feet per second, and an energy of 33,000 foot-tons.

The guns undoubtedly have the advantage in this rivalry, for while there is a practical limit—possibly already reached—to the weight of armor which a vessel can safely carry over her vital parts, there are no indications of near approach to a limit in the weight of projectiles which can be thrown at a high velocity.

Torpedoes as accessories.—Simultaneously with the growth of the armored type of men-of-war, submarine torpedoes have come into use, designed to assault ships from beneath, and thus neutralize the advantages of invulnerability claimed for ships' armor, which at best can extend only a few feet below the water line.

It is not deemed necessary to describe here the several varieties embraced in the two great classes or types into which torpedoes are divided, viz, the *offensive*, or moving torpedoes, and those which are *defensive*, or stationary. All kinds of offensive torpedoes are appropriate aids on either side in a conflict between naval forces. Both offensive and defensive torpedoes are suitable auxiliaries to defense by fortifications. The defensive torpedo is peculiarly adapted to such a purpose, and cannot be efficiently managed from vessels of war.

Being entirely harmless against shore batteries and very destructive against ships, torpedoes have given a great accession of power to a defense by fortifications, and none whatever to a naval attack upon them. They are weapons that can be used against ships of war, but not against forts. Hence, the admitted preponderance of a defense by shore batteries during the age of wooden sailing vessels, supposed to have been partially lost by the introduction of armored steamers, has been more than restored. Fortifications have gained a new and powerful auxiliary. The hostile fleet has relatively gained nothing.

Again, a naval defense receives no strength from the use of torpedoes not equally shared by the attacking fleet, inasmuch as both parties would provide themselves with this new arm, so that the former superiority of a defense by fortifications, as compared with one by naval means, has not been disturbed, or if disturbed at all, has been rather increased than diminished.

It is a popular error, supported by no experience or authority, either military or naval, which assumes that a defense by channel torpedoes, however perfect in itself, can stand alone. To be of any use the torpedoes must be protected from removal by the enemy, the best and cheapest protection yet devised being shore batteries of heavy guns. Otherwise they are a harmless, and therefore a worthless, obstruction. Fortifications and channel torpedoes mutually supplement and support each other. If the torpedoes be omitted an armored fleet can run by the forts without stopping, and perhaps without suffering material injury. If the forts be omitted the enemy could stop and remove the torpedoes at his leisure and then pass on. The experience of our civil war, and of the Russo-Turkish war, furnished ample testimony to the fact that torpedoes which can be approached by the enemy unmolested, afford no defense to a channel and cause but a trifling delay to the passage of a hostile fleet.

Defense by open batteries or earthworks.—It is not only admitted, but claimed by military engineers, that casemated forts built of stone or brick after the old types, do not satisfy the conditions of a good defense against an armored fleet carrying heavy guns, for the simple reason that the scarp wall, which should protect the guns and gunners, cannot withstand the shocks of heavy projectiles. The wall around the embrasure would, with few exceptions, be pierced through and through by a shot from a large rifle. The obvious remedy for this weakness—the one universally adopted in modern practice—is to strengthen the walls with metal shields or armor plating, rather than discard all protection whatever by resorting to open batteries or earthworks, in which both guns and gunners are exposed to full view. Indeed in these open batteries, unless exceptional circumstances favor their being scattered in single guns over a long line, it might not be possible to serve the guns at all, even for a brief period, against armored ships showering grape and canister from large guns and leaden bullets from machine-guns and other rifles. The protection of the cannoneers at their pieces is certainly a consideration of the highest moment. It is indeed an essential consideration. Even in our casemated works a leading object has been to give the least possible room for the entrance of missiles. In those last built, the embrasures, though smaller than ever before, were supplied with iron shutters to stop grape, canister, and rifle bullets. General Totten, late Chief of Engineers, deemed this precaution necessary in order that the cannoneers, even in casemates, might be able to stand to their guns.

The lessons of our civil war, and of all modern wars, so far as justifying a recourse to earthworks for channel defense, all point the other way. At Port Royal our fleet, although composed of wooden vessels only, drove the garrisons precipitately from their works on both sides of the harbor. In the operations before Charleston it was no uncommon sight to see the "New Ironsides" alone silence the fire of Fort Wagner (a very strong earthwork), so that the work in the trenches could proceed unmolested; and on our western waters "running" a battery or "silencing" a battery by such a shower of small missiles as would drive the cannoneers from their pieces became almost every-day occurrences, the important question in such cases being whether the channel itself was free from obstruction.

A depressing carriage.—What is imperatively demanded, besides large guns, to render these barbette batteries effective against a modern fleet, is additional protection to gun and gunners; such protection, at least, as would be afforded by a depressing or counterpoise carriage, automatically arranged to drop the gun behind the parapet at the moment of each discharge and carry it up again into battery when loaded and ready for firing. It should if practicable do even more than this. We need the best depressing system that can be devised, and with the best, our barbette batteries will still be vastly inferior to casemated works in security to guns and gunners, and in the defensive power which that security necessarily confers. With a suitable gun and a depressing carriage, provided with a grape or canister proof shield, or some equivalent device to protect the gunner just before firing, all of our open batteries would be rendered reasonably efficient. In their present condition they are of little value. Attention has been directed more or less to this subject for several years past, and some ingenious and valuable methods for securing the object in view have been devised.

Drawings and brief descriptions of two depressing gun-carriages of comparatively recent origin are appended hereto, viz, those of Lieutenant-Colonel Buffington, of the Ordnance Department, United States Army, and Maj. W. R. King, of the Corps of Engineers, United States Army. The King carriage, carrying a 20-inch Rodman (25 tons) gun, was severely tested with satisfactory results several years ago, under the direction of a board of officers. The Buffington carriage has not been subjected to trial.

There are other inventors in the same direction. For information on this subject, attention is invited to a report made by Maj. W. R. King, Corps of Engineers, to the Chief of Engineers, June 22, 1869.

It is presumed that a very near approach to perfection is not claimed for either the King or the Buffington carriage. At their best they do no more than lower the gun at the moment of discharge, and raise it again for firing. This is excellent as far as it goes, but still leaves a great deal of heavy work to the slow and uncertain process of manual labor.

The perfect carriage will perhaps be operated by hydraulic power stored up by the force of the recoil, and utilized not only for carrying the gun up into battery, but for loading, elevating, and depressing it, and for traversing or changing the direction of fire. Or, what may be still better, all the guns in a fort or battery will be mechanically maneuvered from a central accumulator or reservoir of power. When this point is gained a couple of men to each gun will suffice, and a single company of artillery will supply enough cannoneers for a large work.

Inasmuch as our harbor defenses are largely composed of open batteries, liable in their present condition to be overpowered and rendered practically useless by the fire of a few modern vessels of war, any change which promises to add very greatly to their efficiency, especially a comparatively inexpensive change, like that under consideration, is worthy of prompt and careful attention.

A PERFECT DEFENSE.

A perfect defense by fortifications and channel torpedoes requires, (1) that the batteries be armed with suitable artillery—guns of such construction and calibers that their projectiles will pierce the sides of any vessels that can be brought to the attack—and large mortars to assault their decks; (2) that the cannoneers be protected to such degree that they can serve their pieces even under a storm of small missiles, and (3) that the auxiliary defense by stationary torpedoes be of such magnitude that no fleet can attempt to run the gauntlet through them, without incurring the most imminent risk of destruction.

A defense of this potential character—a defense designed quite as much to prevent an attack as to defeat it—will possess such strength that an enemy confronting it, and compelled to elect whether he will run down the channel torpedoes, or stop under fire to remove them, will prudently elect to do neither. Military engineers deem it entirely practicable at moderate cost to confer this character upon our sea-coast defenses. They are, indeed, a most powerful conservator of the national peace and safety. Their true office is to avert war. They are the guardians if not the champions of the public good, and of the lives and substance of the people, costing but a trifle for maintenance and repairs, drawing no citizens from the useful industries of the country in time of peace, and but few in time of war, and incapable of exerting any influence dangerous to the liberties of the people.

Whether the guns shall be few or many, large or small, whether they shall be placed in open batteries behind earthen parapets, or in shot-proof casemates, behind stone walls or metal shields, or mounted within turrets; and whether the works on the land side shall be made capable of sustaining a siege or only of repelling a *coup-de-main*, are questions to be determined by the width, depth, and other hydrographic features of the channel; the character, altitude, and extent of the sites for batteries; their distance in point of time from needed succor, and the importance of the place to be defended.

If it be true that no antagonist can wisely place his chief reliance upon a single weapon, liable at any moment to be destroyed by his adversary in the heat and chances of conflict, it is equally true that he should not mainly depend upon a weapon which can be as readily procured and as skillfully used by his adversary as by himself. Destructive energy of the same denomination is neutralized when shared by opposing hands. Fleet arrayed against fleet leaves too much to risk and accident, with by far the greater stake on the side of those protecting their homes. These maxims exclude a defense by naval means wherever shore batteries are applicable, and point to the necessity of depending mainly upon those agencies, exclusively our own, which are always able to keep the enemy's fleet at a disadvantage, to wit, permanent forts which he cannot bring with him, and channel torpedoes which he cannot employ.

It is believed that the most zealous advocates of a naval defense will accept this view of its practical and useful limits.

The security of important positions should not, however, be entirely dependent upon any one species of protection. Among the accessories that might be of great value, are torpedo boats and armored floating batteries, capable of being quickly maneuvered, and possesssing ramming properties, light draught, and great speed. A few of these occupying the shoal waters on either side the main channel of approach, and hanging upon the flanks of the hostile fleet, ready to dart out at opportune moment and deliver blows, would be exceedingly formidable.

But all these forces are afloat, and may be neutralized by others of like nature which the enemy can bring from beyond the sea. Rams and torpedo boats on one side against rams and torpedo boats on the other would certainly offer a lively and spirited contest. But we would need to be stronger upon the water than the enemy to insure a safe defense by these means. Having greater interests at stake than he, we could not even afford to divide the risks equally with him.

Captain Ericsson's submarine gun.—In this connection it seems proper to refer to Captain Ericsson's new submarine gun. As this celebrated engineer is not likely to bring forward any invention not possessed of great excellence of its kind, the first thought may be that this new method of projecting torpedoes, by firing them from a gun placed below the water-line, will add relative strength to the defense, or otherwise disturb existing relations between the attack and defense. But no such result can logically ensue. The new device is a floating one, a vessel of war, after all, and granting it to possess destructive power and sea-going qualities in the highest possible degree, it can have no other or greater effect than to hasten and intensify disasters on both sides in combats between fleets. Conceding the claim that this new vessel is to excel, not only in her specialty of submarine artillery, but in speed and safety upon the ocean, she would, of course, form a component part of all good navies, so that neither a purely naval defense nor a mixed defense can derive any strength from her use, not equally shared by the attacking force.

It is difficult to imagine a more untrustworthy or uncertain defense than one depending mainly upon this or any other new or special device, against an enemy equipped quite as thoroughly as ourselves with that device, and having in addition thereto a fleet of armored vessels behind it. Moreover, if this new vessel of war shall be found to excel in destructive power to such a degree as to render the armored ships of the present day, in great measure, powerless and helpless in its presence, those ships would of course be discarded and replaced by the new type, or by some improved form thereof. Supremacy upon the water would then, as now, imply a superior strength upon the water, and a sure defense by floating means would then, as now, require a floating force greater than the enemy's, at each and every point to be protected.

These floating devices, of whatever kind, can therefore be regarded as auxiliaries only, powerful though they may be, to the chief defense by fortifications. It is not even admissible to give less combined strength to the shore batteries and channel torpedoes than they should possess in the absence of this auxiliary aid. Otherwise, when the auxiliaries fail—as they doubtless would if we possessed less strength afloat than the enemy—no adequate defense would remain, and the position would be lost.

It has been asserted that no nation could reach across the ocean with sufficient naval force to match us in our own waters. There are few greater fallacies than this. Moreover, the two strongest naval powers of the world have colonies and excellent harbors and depots at our very doors. Predictions which restrict the possibilities of physical force are proverbially untrustworthy, and not unfrequently return to vex their authors. An eminent scientist once gravely denied the economic feasibility of transatlantic steam navigation, alleging the inability of any vessel to carry both fuel and cargo. Another pronounced the first Atlantic teleegraph enterprise as a visionary scheme, on the assumption that the electric current would not possess working energy at so great a distance.

TORPEDO BOATS AND THEIR ACHIEVEMENTS.

It has been said in the foregoing discussion that if an enemy's vessel carry thick defensive armor, we are forced to use heavy projectiles against it, or our defense is worthless. If any exceptions to this statement can be taken, they will doubtless come from those who have faith in the efficacy of torpedo boats, and other forms of offensive torpedoes, in resisting naval attacks and destroying vessels of war. A few words will therefore be devoted to this branch of the subject.

When this novel and aggressive weapon was first used during our civil war it inspired great terror. Its blows were secret and sudden, and sometimes fatal to both friend and foe. It was an unknown and untried factor in the conflict, and as no proper method of defense against it had yet been devised, the best men felt timid and helpless in its presence. But the experiences of the last Russo-Turkish war were of another character. Its destinctive features had gradually adjusted themselves to vision, and were brought within the powers of arrangement and classification. It was soon found that the dreaded torpedo boat could be easily dealt with. Lapse of time had shorn it of many of its terrors, and thenceforth it took the form of a familiar antagonist, so that assaults from torpedo boats came to be accepted as among the ordinary incidents of naval warfare. Having ceased to inspire terror, they were usually met with the coolness habitual in other kinds of combat, and were repulsed with almost unvarying success. Measured by the ratio of successes to failures, the offensive torpedo played a very unimportant, and in some respects a ludicrous part in that war.

Even its moral effect—its power over the imagination—counted for little after the first few months, differing greatly in this respect from the sunken or channel torpedo, which exercised a most demoralizing influence on the Turkish flotilla on the Danube, and practically neutralized its power. The efficacy of the sunken torpedo, when properly managed, is beyond question.

Brief descriptions of all the attacks made with torpedo boats during that war, gathered from official and other trustworthy sources, will be instructive in this connection. They are given below.

The Russian torpedo launches were, with few exceptions, built of thin iron or steel plates. Some of them were ordinary wooden ship-launches, with thin plating, and a light iron or steel hood or shield at the bow. These had a speed of about 6 knots. Others were from 30 to 35 feet long, fitted with a steam-engine of about 8-horse power, were exceedingly light, possessed considerable speed, and carried partially bullet-proof shields at each end. Some of them, when in action, were similarly protected overhead. They were not proof against canister or even against leaden bullets, except when standing end on. Some of the launches were of the more powerful Thorneycroft type, about 50 feet long, with a speed of 16 to 17 knots per hour.

On the 26th of May, 1877, just before daybreak, 4 Russian spar-torpedo launches, commanded by Lieutenant Dubassoff, from whose official report this description is condensed, approached two Turkish iron-clads and a wooden vessel lying in the Matchin branch of the Danube, and sunk the Seifé, a 2-inch armored gunboat of light draught, mounting 2 80-pounder rifles on deck near the bow, and 2 smaller guns at the stern. One of the launches directed its attack against the stern of the vessel with a view of destroying the screw, and succeeded in planting a torpedo against the vessel at some distance from the stern-post. The torpedo was fixed to the end of a spar and was discharged by electricity. The explosion which followed threw some of the *débris* into the air to a height of nearly 125 feet. The iron-clad began to settle down at the stern, and shortly afterwards another spar torpedo was planted by a second launch and exploded under the keel. Another terrific explosion followed, and the boats withdrew. The vessel went down in a few minutes. The launches, as they advanced to the attack, were hailed when about 70 yards distant, and 3 cannon shots were fired and passed over their heads before the first torpedo was planted. Other cannon shots followed; and a brisk musketry fire was also kept up from the iron-clads and the other Turkish steamer throughout the attack and while the launches were getting away, causing considerable damage to the latter, but no loss of life.

On June 20, in broad daylight, according to the official report of the Grand Duke Nicholas, the powerful torpedo launch Schutka, commanded by Lieutenant Skrydlow, attacked a Turkish monitor in the Danube, off Parapau, a little above Giurgevo. The report states that "Lieutenant Skrydlow made straight for the monitor and lodged the torpedo, but the wire being cut by the enemy's bullets the mine did not explode, and the launch had to retreat." The commander of the launch and most of his companions were wounded by musketry fire.

Another unsuccessful attack upon a Turkish monitor took place on the 23d of June, in daylight, on the Danube, off Flamunda, near the mouth of Aluta. The Grand Duke describes the affair in the following words:

> There were at this moment at Flamunda only five steam sloops (torpedo launches); three were damaged, but the two remaining ones at once entered the stream and fiercely attacked the Turkish vessel, notwithstanding the hailstorm of balls and bullets discharged at them. Marine Ahrens, with the sloop Mina, was the first to attack the monitor, and but for a bomb cutting the wire of the torpedo battery would have sprung his mine. His sloop was hurt and obliged to fall back. After this, Ensign Niloff, in the Schutka, threw himself upon the monitor, and luckily avoided a torpedo placed in front of the Turkish vessel. While going past the monitor's prow, at a *sazhen's* distance (2¼ yards), Ensign Niloff fired three shots from his revolver at the Turkish captain. The splash of a bomb beat against the right side of the sloop. The monitor, veering her prow, turned away from the mine. Ensign Niloff then tried to get at their left side, but his vessel being half filled with water and going slowly in consequence, the monitor succeeded in retreating to Nikopolis.

On the 12th of May, during the night, four torpedo launches, of which three were fitted with the electric outrigger torpedo and one with a towing torpedo, were dispatched from the Russian ship Grand Duke Constantine lying off Batoum to attack the Turkish iron-clads in that harbor. No defensive torpedoes were met with in the channel, and one of the boats armed with a kind of Harvey torpedo, reached a paddle-wheel steamer doing duty as a guard-ship off the harbor. The torpedo struck the bow of the vessel but would not explode. The boats then quickly drew off under a brisk fire from the Turkish ships. The latter were not protected by steam guard-launches, or by obstructions of any description.

In the night of June 10 to 11, an attack was made by six torpedo launches, two of them being Thorneycrofts, towed by steamer from Odessa, upon three Turkish iron-clads at anchor off the Sulina mouth of the Danube. One launch had a towing torpedo; the others were fitted with electro-outrigger torpedoes. They failed of any success, although not, as stated in earlier reports, in consequence of the Turkish vessels being encircled by a line of boats connected together by ropes or chains. This method of protection, devised by Hobart Pasha, was not used in this case. It is reported that the screw of the boat having the torpedo in tow fouled in the towing line. One of the Thorneycroft boats, making for the bow of an iron-clad, struck her cable, swung alongside, and exploded her torpedo in so doing, but without effect. Two of the torpedo boats were lost, one being struck by a shell, and the other captured by the enemy. When advancing to the attack, the launches were hailed at 70 yards distance, and immediately thereafter a violent musketry fire opened upon them, which was kept up until the conflict ended.

On the night of August 19 to 20, four torpedo launches, under command of Lieutenant Zatzarerina, were sent from the Russian ship Grand Duke Constantine to attack an iron-clad man-of-war at the port of Sonkomekali on the Circassian coast. The night was dark. The Turkish gunboat was discovered at anchor, with boats rowing around her on guard. At the first alarm lights were lit, and before the torpedo boats reached the vessel a brisk musketry fire was opened upon them. Three of the launches carried spar torpedoes and the fourth followed closely by to afford succor in case of necessity. The attack was over in a few minutes, and it was claimed at the time that three torpedoes were exploded against the sides of the Turkish vessel. This was probably not the case, as the vessel was not sunk or injured. The four launches were withdrawn without loss of life on the side of the assailants.

On the 20th of December, 1877, in the night-time, an attack was made on several Turkish ships at anchor in the harbor of Batoum. Four boats made the attack. Two were provided with the Whitehead fish torpedo, and two with the ordinary spar torpedo. The Turkish vessels were protected by a barrier made of logs having planks spiked to them and so weighted that the planks assumed a vertical position in the water. The attack failed. Subsequently two Whitehead torpedoes were found high and dry on the beach near by, one in good condition and the othe with its head and magazine gone.

The foregoing record comprises all the achievements of torpedo boats, and every form of offensive torpedo, during the late Russo-Turkish war. Of the seven attacks delivered, six were conspicuous, and some of them disastrous failures, and yet they were conducted with skill and bravery and the launches used were, on the whole, of fairly good type. Some of them excelled in speed and in all the requisite appointments. On the other hand the defense was not specially good in any case, and on the Danube, in particular, the officers of the Turkish flotilla were generally considered to be notably unskillful and inefficient.

Judged by these latest tests of actual war, as well as by more recent trials, the policy that would risk the security of any locality deemed worthy of protection to a defense by torpedo boats, or would rely upon such uncertain devices as important auxiliaries in that defense, must be regarded as extremely shortsighted and unwise.

Hobart Pasha, commanding the Turkish navy, not the best authority, perhaps, thus sums up the torpedo experience of the war:

> In the Danube they succeeded in destroying (though, it must be admitted, a bad lookout having been kept) one small gunboat with the spar torpedo, and at the Sulina mouth a similar vessel was destroyed by the over-confidence of her captain, who followed a Russian flotilla over water where the enemy had been maneuvering for several days and laid down many contact torpedoes. The vessel was naturally blown up by the trap laid for her. In the Black Sea, though many desperate and carefully organized attacks were made, not one Turkish vessel was injured by torpedoes.

The loss referred to at the Sulina mouth occurred on the 9th of October, during the forenoon, where the Turkish seagoing iron-clad Suna, 5 guns, while on a reconnaissance on the Danube near Sulina, was sunk by a contact channel torpedo. Two of her officers and two sailors were killed and several wounded.

With regard to the Whitehead fish torpedo, from which so many and so great things were expected, the only other authenticated instance of its use in actual combat is supplied by the fight between two English wooden ships, the frigate Shah and the corvette Amethyst, and the Peruvian iron-clad ram Huascar, off the Peruvian town Ylo, on the 29th of May, 1877. In that instance it was a conspicuous failure. Captain Garcia, of the Peruvian navy, reviewing that action, says:

> The Shah fired several torpedoes during the action, the famous Whitehead torpedo appearing to be one of her specialties; but as their presence in the water is made known by a wake, the Huascar found it an easy matter to escape them.

An officer of the Shah states that one Whitehead torpedo was sent against the Huascar at right angles to her course; that she was then steaming about 11 knots, while the torpedo moved only about 9 knots; and that it was easily avoided by the iron-clad.

Mr. C. W. S. Sleeman, of the Imperial Ottoman navy, in "Engineering" for December 20, 1878, says:

> Of course such an attack [an attack by torpedo boats] must always, more or less, partake of the nature of a forlorn hope, an additional reason for supposing that if ordinary precautions are taken to defend the ship attacked, in nine cases out of ten the torpedo attack will result in failure.

As one of these ordinary precautions, methods of passive defense can be adopted against moving torpedoes, such as a netting of wire cable or some other species of strong flexible screen suspended around a vessel at some distance from the hull, which promises to be an efficient protection, not only against ordinary torpedo launches, but against every variety of mechanical or fish torpedo. Larger boats and rams, whether armed with torpedoes, submarine artillery, or otherwise, are simply vessels of war, to be met by force of the same character. They are all valuable auxiliaries to a main defense by fortifications and channel torpedoes, because in skillful hands they are destructive against ships, and, in proportion to their destructive powers, they would be adopted into all navies and would, of course, form part of the equipment of all attacking fleets. Hence, before we can wisely depend upon them, or upon any combination of them with more powerful craft, as the principal defense, we must be stronger than the enemy upon the water at each and every point requiring protection. This conclusion seems to be inevitable, reason as we may.

The stationary sunken torpedo, however, and every type of channel torpedo which constitutes the appropriate adjunct of permanent fortifications, present themselves under other conditions. They cannot, like the aggressive or moving topedo, be said to have disappointed the high expectations created by their early history. But their effects must be estimated by a standard of their own. A good one, perhaps, would be found in the measure of adverse force which they are able to neutralize—the fruitless inactivity which they can impose upon the enemy—an intangible factor which evades computation.

The extent to which the channel torpedoes, maintained or supposed to be maintained in Russian harbors, paralyzed the efforts of the Ottoman navy, although in some measure yet an open question, contains the gist of the whole matter. Whether their existence was real or imaginary is immaterial. We know that the ports in some instances were protected, and, in others, were believed to be protected, by torpedoes. We also know that they all enjoyed a singular immunity from insult or annoyance, and that the Turkish men-of-war on the Black Sea were principally occupied in convoying store and troop ships. Officers of the Ottoman navy appear to be somewhat sensitive concerning their achievements during that war, and while their admiral in command very justly extols their repeated victories in repelling the assaults of torpedo boats, in the dearth, perhaps, of offensive deeds of skill and daring worthy of note, another officer, from whose article in "Engineering" a quotation has already been made, attributed the security of the Russian ports to the inherent power—to what might be termed the latent force—of a defense, either real or imaginary, by means of channel torpedoes.

If the views taken in the foregoing discussion be correct, viz, that permanent fortifications and channel torpedoes, aided in certain cases by rams and other floating accessories, can supply a sure and comparatively cheap defense for our sea-coast establishments, and that a defense by means purely or mainly naval must necessarily be either inordinately expensive or very defective and weak, the question will naturally arise: what, then, are the exclusive and appropriate duties of the Navy?

Without venturing to advance any views of my own on this branch of the subject, I would say that the answer, derived from high naval authority, might be, that inasmuch as aggressive war is the special mission of that arm of the service, the country would expect it to protect our commerce on the high seas and convoy it safely into port; enforce respect for our flag in foreign ports; capture the enemy's merchantmen and destroy or confiscate his goods contraband of war; search out and engage his armed fleets; blockade his ports; and generally, as Admiral Dupont once said, "carry the sword of state upon the broad ocean," and "contend for the mastery of the seas where alone it could be obtained, on the sea itself."

For the discharge of these exalted duties our sole dependence would be upon the Navy, and it should not only combine in the highest degree and under approved methods, all those elements of aggressive power possessed by war vessels of modern type, but it should be free to employ that power abroad and not be compelled to fritter it away in vain and fruitless attempts to protect a long line of sea-coast, for which all appropriate means of defense had been neglected.

I will only add that the foregoing discussion, which has reached a length far beyond what was originally intended, does not presume to advance new ideas or cover new grounds, and while it neither invites nor shuns professional criticism is not specially addressed to the technical expert in military or naval affairs. On the contrary, the wish has been to reach that larger class of intelligent thinkers who mold the ideas and dictate the laws of the nation, but who, having had their attention habitually directed into other channels, have not formed or had occasion to form any fixed opinions upon the subject of which it treats.

Very respectfully, your obedient servant,

Q. A. GILLMORE,
Lieut. Col. of Engineers, Bvt. Maj. General.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

BRIEF DESCRIPTION OF BUFFINGTON'S COUNTERPOISE GUN-CARRIAGE.

Consists of two parts, viz: A chassis and top carriage. The chassis may either be the chassis of the present 8, 10, 13 and 15-inch smoothbore gun-carriages, built up to required height and slightly altered in front, and transoms arranged to suit the system, or they may be built up each rail or cheek in one piece. The front edge of each chassis cheek, or rail, is to be, when the carriage is mounted on the platform, perpendicular to pintle bed, and consists of a single cast-iron piece, having a ratchet and bearing-surface along the side of it, for the shoe-brake, and extends above the top of cheek about half the diameter of front wheels of truck of top carriage.

The top carriage consists of a four-wheeled truck, the front axle of which carries inside of the wheels two—what may be called—levers which support the gun at one end and the counterpoise at the other; the rear axle carries two upright bars united by link-joints to two other horizontal bars which are so arranged in front as to carry the trunnions of gun, and rest upon the front levers.

To this rear axle another axle is bolted carrying two friction rollers which work inside of cheeks and against the underside of overlapping T irons on top of chassis cheeks. These four bars, so arranged, constitute a system that performs the work only of overcoming the friction produced by the weight of gun and counterpoise on the trunnion bearings of levers, and preserves the axis of gun, in running to and from battery, parallel to the starting position.

The counterpoise is attached to the levers by means of an axle passing through the counterpoise box and lead, at the bottom and in front of the center. This last-named axle carries two pinion wheels, which work in the ratchet above-named, and these wheels have, immediately adjoining the geared portion, smooth cylindrical surfaces for the friction bands of two automatic shoe-brakes, working, as above stated, against the iron edge pieces of chassis cheeks. The sides of counterpoise box are arranged to work as a "cross-head" on the inner surfaces of these cast-iron pieces of chassis.

The counterpoise of lead required to balance a 15-inch gun is about 31,250 pounds with the improved carriage, but to overcome friction the working counterpoise should be about 38,600 pounds.

The dimensions of carriage are based upon an 11-foot breast height.

WATERVLIET ARSENAL, *July* 8, 1881.

KING'S COUNTERPOISE GUN-CARRIAGE.

The drawing will be understood by those familiar with the ordinary carriages without a detailed description.

The *pintle block*, *traverse circles*, *traverse wheels*, *props*, and *chassis* are like the old ones excepting that the chassis is longer and slopes 20° to the rear, the front end being raised about 7 feet above the pintle block.

The *pintle* is hollow, 10 inches inside diameter and 1 inch thick.

The *counterpoise* is made, for convenience in handling, in disks 1 foot thick and moves in a *well* 13½ feet deep under the pintle block. The *pulleys* in the counterpoise and chassis are grooved for four 1⅜-inch wire ropes. These *ropes* are made of six strands, with nineteen steel wires to the strand, and a core of soft iron wire. The ropes are of equal length, and can be fitted with iron knobs at the factory, so as to require no adjustment after they are put in place. One end of each rope is held by a socket at the front of the pintle block, and the other by a socket hinged to the under side of the top carriage near its front end.

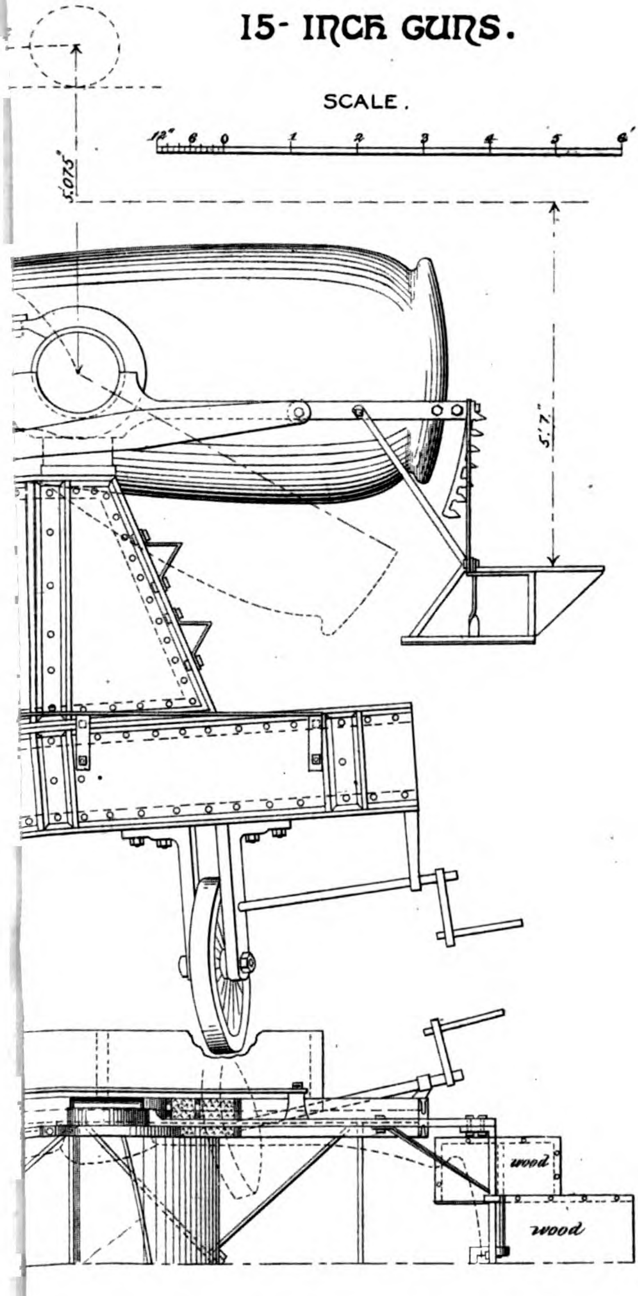
The *top carriage* is so made that when the rear *truck wheels* are thrown "in gear" the weight of the gun is thrown upon the front wheels also; in fact over two-thirds of the weight then comes upon the front wheels; but when "out of gear" nearly the whole weight slides. The throwing into and out of gear is done by two or more men turning the *hand wheels* at each side and just below the breech of the gun; and the weight of the counterpoise is such that when in gear the gun will run up into battery, but when sliding, as during recoil from firing, the top carriage will remain wherever it stops.

The *elevation* of the gun, in pointing, is given by the same hand wheels, the operation being controlled by the gunner, as shown in the plate, while two other men turn the wheels.

In *loading*, Nos. 1 and 2 stand upon a platform inside the chassis, and the shot is rolled to them from a rack along the breast-height wall.

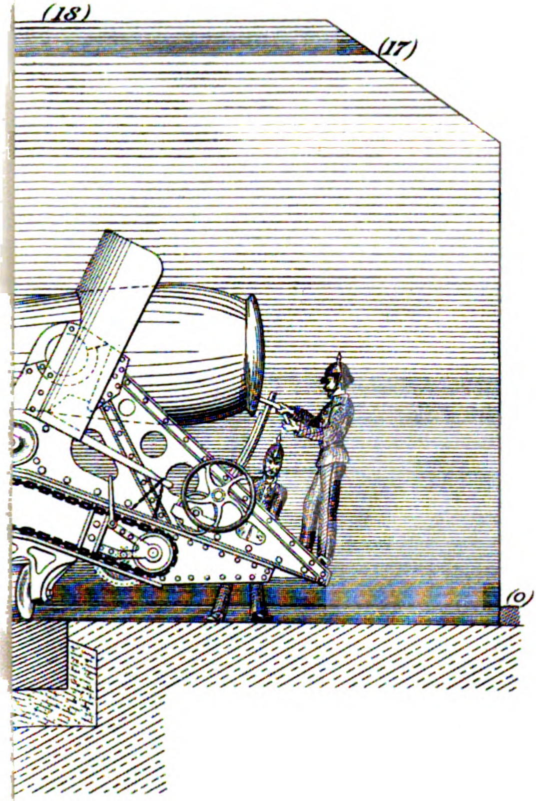
Both elevation and horizontal direction can be given while the gun is

BUFFINGTON'S
COUNTERPOISE GUN CARRIAGE
FOR
15- INCH GUNS.



tter to the Chief of Engineers dated July 15th 1881

. A. Gillmore
Col. Engrs Bvt. Maj. Genl. U.S.A.



ION AND ELEVATION

— OF A —

DISE GUN-CARRIAGE

EMPLACEMENT

FOR

5 INCH GUNS.

under cover of the parapet; and, as suggested by General Gillmore, the gunner can easily have additional protection during this operation by attaching a light cylindrical *shield* of *steel* to the top of the carriage, as shown in the drawing.

In actual service the gun is carried back under cover for loading by the recoil, and "into battery" by the counterpoise; but for purposes of drill the top carriage is run "from battery" by the endless chains at the side, actuated by the cranks near the rear end of the chassis.

The original carriage, differing only in certain details from that here represented, was first mounted at Fort Foote, Maryland, and afterwards at Battery Hudson, New York Harbor. It was tested at various times during the four years beginning February, 1869, by boards of engineers, ordnance and artillery officers.

Weight of gun	pounds	50,000
Weight of counterpoise	do	47,900
Slope of chassis		20°
Maximum recoil	feet	17.5
Descent of gun	do	6
Number of ropes (steel wire)		4
Diameter of ropes	inches	1¼
Ultimate strength of each	pounds	118,000
Ordinary strain upon each	do	6,000
Maximum strain in firing	do	31,000
Caliber of gun	inches	15
Weight of shot	pounds	450
Charge (mammoth powder)	pounds	100
Elevations from		3° to +30°
Horizontal traverse		130°+
Number of cannoneers		6 to 8
Minimum time of loading (with undrilled men)	minutes	2
Number of rounds fired with 100-pound charges		145
Number of rounds fired, including smaller charges		193

APPENDIX No. 3.

BATTALION OF ENGINEERS AND ENGINEER SCHOOL OF APPLICATION.

REPORT OF LIEUT. COL. H. L. ABBOT, CORPS OF ENGINEERS, BVT. BRIG. GEN., U. S. A., OFFICER IN COMMAND, FOR THE FISCAL YEAR ENDING JUNE 30, 1881.

ENGINEER SCHOOL OF APPLICATION,
Willets Point, New York Harbor, July 11, 1881.

GENERAL: I have the honor to submit the following as my annual report upon the Battalion of Engineers and the Engineer School of Application, for the year ending June 30, 1881:

STATIONS AT THE BEGINNING OF THE YEAR.

At Willets Point, New York Harbor, field, staff, and band, and Companies A, B, C, and D.
At West Point, Company E.
On field duty, Department of the Missouri, 1 private.
On field duty, Department of Dakota, 1 private.

MOVEMENTS DURING THE YEAR.

First Lieut. E. Griffin, Corps of Engineers, proceeded August 4, 1880, to Governor's Island, New York Harbor, to compete for a place in Military Division of the Atlantic Rifle Team, in compliance with letter dated Adjutant-General's Office, Washington, July 27, 1880, and rejoined September 22, 1880, as per Special Orders 45, headquarters Military Division Atlantic, Governor's Island, September 20, 1880.

First Lieut. G. McC. Derby was absent on detached service from March 28, 1881, until April 5, 1881, to establish grade lines of the parade ground at David's Island, in compliance with instructions from Adjutant-General's Office, Washington, dated March 17, 1881.

Private Walker, Company A, was ordered to proceed to Saint Paul, Minn., and report to the Engineer officer, headquarters Department of Dakota, for duty, as per Special Orders 25, headquarters Battalion of Engineers, June 30, 1880. Left post July 1, 1880.

Changes in personnel during the year.

Rank.	Names.	Dates.	Joined or relieved.	Remarks.
Second lieutenant	Lusk, James L	Aug. 23, 1880.	Relieved	Special Orders 99, headquarters Army, May 5, 1880.
Second lieutenant	Roessler, Solomon W	Aug. 27, 1880.	....do	Do.
First lieutenant	Fisk, Walter L	Sept. 14, 1880.	....do	Special Orders 194, headquarters Army, September 11, 1880.
Second lieutenant	Carter, Oberlin M	Nov. 27, 1880.	Joined	Special Orders 244, headquarters Army, November 15, 1880.
Second lieutenant	Goethals, George W	Nov. 27, 1880.	....do	Do.
First lieutenant	Willard, Joseph H	Jan. 3, 1881	....do	Special Orders 255, headquarters Army, December 1, 1880.
Captain	Quinn, James B	May 2, 1881	Relieved	Special Orders 83, headquarters Army, April 12, 1881.
First lieutenant	Derby, George McC	June 3, 1881	....do	Special Orders 109 and 120, headquarters Army, May 12 and 26, 1881.

Second Lieut. O. M. Carter assigned to duty with Company C. Second Lieut. G. W. Goethals assigned to duty with Company A, per Special Orders 43, headquarters Battalion of Engineers, Willets Point, November 28, 1880.

First Lieut. E. Griffin was, in addition to his duties as Battalion quartermaster and recruiting officer, acting assistant quartermaster and acting assistant commissary of subsistence, appointed Battalion adjutant and treasurer, and commanding Company D, per General Orders 13, headquarters Battalion of Engineers, Willets Point, September 14, 1880, and post-adjutant and treasurer and signal officer, per General Orders 18, headquarters Willets Point, September 14, 1880, relieving First Lieut. W. L. Fisk, Corps of Engineers.

First Lieut. J. H. Willard was appointed Battalion adjutant and treasurer and commanding Company D, per General Orders 1, headquarters Battalion of Engineers, Willets Point, January 3, 1881, and post adjutant and treasurer and signal officer, per General Orders 1, headquarters Willets Point, January 3, 1881, relieving First Lieut. E. Griffin, Corps of Engineers, from these duties.

RECRUITING.

No special system of recruiting has been necessary. Men applying at Willets Point and West Point are enlisted to fill vacancies, if able to fulfill the requirements for the Engineer service, and deficiencies are supplied from the general depot at David's Island by careful selection. Aided by numerous re-enlistments, this method has proved sufficient to keep the Battalion nearly filled to the authorized standard at all times during the past year.

Enlisted at Willets Point	14
Re-enlisted at Willets Point	20
Enlisted at West Point	5
Re-enlisted at West Point	10
Recruits from David's Island	4

The following table exhibits a synopsis of recruiting service and desertions from June 30, 1865, to June 30, 1881, a period of sixteen years:

During—	Enlisted.	Re-enlisted.	Deserted and apprehended.	Deserted after enlistment.							
				First three months.	Second three months.	Second six months.	Second year.	Third year.	Fourth year.	Fifth year.	Total.
Third quarter, 1865-'79	681	89	46	137	132	87	81	23	3	0	463
Fourth quarter, 1865-'79	660	121	54	109	71	33	28	9	0	1	251
First quarter, 1866-'80	609	129	83	68	95	67	37	6	1	0	274
Second quarter, 1866-'80	486	61	34	102	123	97	40	12	0	1	375
Third quarter, 1880	7	11	0	2	1	1	1	0	0	0	5
Fourth quarter, 1880	4	12	1	0	0	0	3	0	0	0	3
First quarter, 1881	5	6	0	1	0	0	0	0	0	0	1
Second quarter, 1881	3	1	0	0	0	0	0	0	0	0	0
Grand total for 16 years.	2,455	430	218	419	422	285	190	50	4	2	1,372

STATIONS AT THE END OF THE YEAR.

On June 30, 1881, the Battalion was stationed as follows:

At Willets Point, New York Harbor, field, staff, and band, Companies A, B, C, and D.

At West Point, New York, Company E.

On field duty, Department of the Missouri, 1 private.

On field duty, Department of Dakota, 2 privates.

The strength of the Battalion is 14 commissioned officers and 199 enlisted men.

The following is a

ROSTER OF THE OFFICERS OF THE BATTALION ON JUNE 30, 1881.

Lieut. Col. H. L. Abbot, Corps of Engineers, commanding.
First Lieut. J. H. Willard, Corps of Engineers, adjutant.
First Lieut. E. Griffin, Corps of Engineers, quartermaster.

Company A.

First Lieut. F. V. Abbot, Corps of Engineers, commanding company.
Second Lieut. C. McD. Townsend, Corps of Engineers, with company.
Second Lieut. G. W. Goethals, Corps of Engineers, with company.

Company B.

Capt. A. M. Miller, Corps of Engineers, commanding company.
First Lieut. T. L. Casey, Corps of Engineers, with company.
Second Lieut. G. J. Fiebeger, Corps of Engineers, with company.

Company C.

Capt. J. C. Mallory, Corps of Engineers, commanding company.
First Lieut. T. A. Bingham, Corps of Engineers, with company.
Second Lieut. O. M. Carter, Corps of Engineers, with company.

Company D.

First Lieut. J. H. Willard, Corps of Engineers, commanding company.

Company E.

Capt. C. W. Raymond, Corps of Engineers, commanding company.
First Lieut. H. S. Taber, Corps of Engineers, with company.

MILITARY DUTIES OF THE BATTALION.

The 3 companies at Willets Point (146 enlisted men) guard and care for the public property, comprising investments represented by the following figures:

Fortifications for defending New York Harbor	$1,387,000
Public buildings	142,500
Public lands (136 acres)	258,000
Ordnance and ordnance stores	200,000
Torpedo materials	665,000
Depot property, bridge trains, tools, instruments, &c	500,000
Total	3,152,500

These troops also perform much useful work, such as remodeling parts of the ponton trains, printing confidential Engineer documents, repairing public buildings, continuing the trials for perfecting our torpedo system, &c.

The company at West Point (50 enlisted men) has performed ordinary garrison duty and aided in instructing the cadets in field fortification, pontoniering, and military signaling. It has also received theoretical and practical instruction suited to maintain its efficiency.

The men (3) detached on military duty in the Departments of the Missouri and Dakota have served under the orders of officers of the corps attached to the staffs of the commanding generals.

THE ENGINEER SCHOOL OF APPLICATION.

When the Army of the Potomac was disbanded at the close of the war the headquarters and 3 companies of the Engineer Battalion were ordered to take station at Willets Point. The post had been occupied as a general hospital, but never as a permanent military station. The old temporary buildings had to be removed and new ones constructed by the troops; the immense stores of Engineer property forwarded from the field had to be arranged, classified, and stored for preservation; the grounds had to be put in order—a work of no little labor, involving as it did the removal of many hundreds of tons of drift bowlders now buried in the foundations of the permanent buildings.

Nearly as fast as order could be evolved from chaos the strength of the companies was successively reduced, and fatigue details continued so nearly to absorb the available force as to interfere seriously with any systematic course of instruction. Then followed the long and very laborious series of trials, under the direction of the Board of Engineers, designed to develop our system of submarine mining for defending the coast with torpedoes.

During all this time, the plan was kept steadily in view to ultimately create here a school of application which should supply a need long felt in the Engineer service. Officers on joining the Corps had been ordered directly from West Point as assistants on military or civil works in charge of officers of their branch of the service, without being afforded any opportunity of serving with troops, or of acquiring practical knowledge in the use of the instruments and methods with which they had become only theoretically acquainted at the Military Academy.

Thus for years they were liable to find themselves in awkward positions from the want of practical knowledge in some untried branch of their duty.

The Engineer troops, although usually stationed at West Point, had occasionally served on the frontier, in Utah and Oregon, and rarely had facilities for instruction in the new applications of modern science to the details of their duties as sappers, miners, and pontoniers. In a word, both officers and men needed advantages similar to those extended to the Artillery, by the organization of the school at Fortress Monroe.

The Chief of Engineers, as early as 1868, inaugurated the custom of assigning all recent graduates to duty with the troops for a term of 2 or 3 years; and this practice has been steadily followed since that date. He also instructed the Battalion commander to afford them every possible facility for acquiring a practical knowledge of the duties, both military and civil, upon which they were liable to serve.

In carrying out this system, a field astronomical observatory was erected at Willets Point, in 1868; regular series of meteorological observations were begun in 1868; practice in making reconnaissances and surveys dates from 1868; the use of photography for duplicating maps in the field was added in 1873; tidal and current measurements began in 1871; while drills in field fortifications, sapping and mining, pontoniering, infantry tactics, and target practice have always received as much attention as the more pressing duties of the troops would permit. So soon as the trials had sufficiently developed, our system of submarine mining laboratories were prepared, and officers and men have received careful training and instruction in the various branches of science upon which success in this new mode of warfare will depend.

For the last few years, since the post has become essentially complete, and the public property has been securely stored, increasing attention has been devoted to perfecting the details of instruction in these several branches; until, at length, Willets Point has become an efficient school of application for the Engineer service.

The general system carried out during the past year is set forth in my Orders No. 15, series of 1880, and No. 4, series of 1881, of which copies are appended.

The work of the officers in astronomy is reported in Orders No. 3, series of 1881, to which I would especially invite attention, as containing a full description of the observatory, and of the system adopted, after an experience of twelve years, in preparing for this important branch of the duties of the Corps of Engineers. In connection with the auroral records, I may add that Private Thomas Murphy, Company B, the watchman on post No. 3, on the night of June 22, 1881, discovered the new comet at 2 hours 20 minutes a. m., which is as early an hour as I have seen claimed in the newspapers by any party. This fact has been certified to the proper authorities, with a view to having his name entered among the competitors for the Warner Observatory prize.

In meteorology and barometric hypsometry the results are reported in appended Orders No. 6, series of 1881, to which I would also invite attention as showing unusual interest and research on the part of the officers.

The usual routine of instruction in the torpedo service has been extended during the past year by the admission of a class of artillery officers, under the provisions of General Orders No. 65, Adjutant-General's Office, series of 1880, to qualify as acting engineers in the duties of submarine mining. I append a copy of my Orders No. 2, series of 1881, which contains all information needed as to the working of this experiment, which, in my judgment, has proved to be entirely successful and productive of excellent results. It has formed the subject of a special report to the General of the Army, already forwarded through regular channels.

In military photography as good progress has been made as the inadequate accommodations of the building render possible. I append the report of the officer in special charge, Captain Quinn, which gives all needful details, and with whose views I concur.

Current measurements were again interrupted, first, by the delay which occurred in supplying the vacancy created by detaching my adjutant, Lieutenant Fisk (who would have had direction of the work), early in the season; and, secondly, by the necessity of renewing the pile foundations of the self-registering gauge-house, carried away by ice last winter. These repairs have now been made, and the work will receive attention during the present season.

The usual surveys and reconnaissances have been well executed, both by officers and enlisted men. The latter have had more thorough instruction in the use of the transit and level than heretofore, in order to render them sufficiently expert to be of service in this class of work when planting submarine mines.

The winter theoretical instruction of the non-commissioned officers was satisfactorily carried out by the company officers, and I append a copy of Orders No. 5, series of 1881, announcing the subjects taught and the standing therein.

The troops have been exercised in the manual part of their duties as sappers, miners, and pontoniers, so far as their reduced numbers and the needs of the post and depot have permitted. It should be understood that more men are absolutely necessary before any reasonable preparation for a satisfactory performance of their duties in time of war can be made.

In pontoniering it is necessary to unite the companies; and even then the total available force is insufficient to construct a bridge in a proper manner, or with proper celerity. The men are well taught and skillful, but they are too few in numbers to perform the mechanical work.

In field fortification and sapping the expedient of working on a scale of 2 inches to the foot in molding sand has supplied to a certain extent the deficiency of men; and the command is well trained in their duties as overseers of working parties in front of an enemy.

In land-mining drills have been restricted to experiments in boring for camouflets to be operated with the aid of dynamite or explosive gelatine. Here, again, the strength of the command is insufficient for the practice needful to keep pace with modern methods.

The Battalion is well instructed in infantry drill, to include the school of the company; but the numbers are insufficient for battalion drills upon a scale large enough to be of much value.

As heretofore, the records of the target practice show excellent results, attributable to the care taken by the company officers at the range, and to the interest of the men in the work. For details I would refer to appended Orders No. 14, series of 1880, and No. 7, series of 1881.

The extension and arrangement of the new Engineer museum, mentioned in my last report, has been continued, and it bids fair to soon become a very useful and attractive addition to the post.

In fine, I am able to report that during the past year steady progress has been made in placing the school of application upon a proper footing. The great want is more enlisted men; and as the necessity of having a large number in training for defending our coasts with torpedoes becomes better appreciated, this may, I hope, be removed. There will be no need of retaining the entire number here and at West Point, provided the Battalion be recruited to its legal organization (752 enlisted men). After passing through the needful training large details can be sent west for military reconnaissance and map-making under the officers of the Corps attached to the staffs of the generals commanding departments. Trained soldiers of Engineers are greatly wanted for this work, and applications have to be constantly refused because our present numbers are insufficient to supply the demand. Useful employment is thus awaiting the men as soon as they are properly instructed. On the outbreak of war with a maritime power they would be recalled, and at once put to work in planting the mines upon which the safety of our sea-board cities will depend, but which will never be successfully served without such a reserve of skilled miners.

Very respectfully, your obedient servant,

HENRY L. ABBOT,
Lieut. Col. of Engineers,
Brt. Brig. Gen. U. S. A., Commanding.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

SAINT LOUIS, MO., *May* 31, 1881.

SIR: I have the honor to submit the following report upon the operations of the school of photography during that portion of the past year I remained in charge.

The system of instruction introduced the preceding year was adhered to as far as the limited facilities would admit; the officers receiving the theoretical instruction the preceding year were given opportunities to make practical application of their knowledge of the different processes employed, and the new appointments were instructed in the theory and practice of photography and given such practical instruction in the application of photography to military purposes as the limited time would permit. The crowded condition of the studio has materially interfered with the usefulness of the school. This was particularly to be regretted since the non-commissioned officers were unavoidably deprived of the opportunities to use the apparatus as often as required, and therefore their progress has not been as satisfactory as was to be expected.

The dust floating in the air of the studio during the time that it was necessary to keep fires in the stoves has prevented the working up of several processes which were believed to be of considerable value for military purposes, and of which the details were but imperfectly known.

Some difficulty also occurred during the cold weather in keeping the various solutions from freezing during the nights, or maintaining them at proper temperature when in use. This necessarily causes a good deal of delay, and materially affects the quantity and quality of the work performed. The building is certainly unsuited to the requirements of the different purposes for which it is attempted to adapt it, and the necessity for a better and more commodious building is painfully apparent. In my last report attention was invited to this want, and I take the present opportunity of again urging the necessity of building better accommodations for the photographic school as an essential factor in its future useful advancement.

Very respectfully, your obedient servant,

JAMES B. QUINN,
Captain of Engineers.

The ADJUTANT, *Battalion of Engineers, U. S. A.*

[General Orders No. 14.]

HEADQUARTERS BATTALION OF ENGINEERS,
Willets Point, New York Harbor, November 20, 1880.

I. The following is announced as the result of the target practice of this Battalion for the year ending October 31, 1880:

In individual firing the companies were practiced at the several ranges, each man firing ten consecutive shots. The following table exhibits the best scores thus obtained, showing the percentage of the maximum possible at each distance (fifty times the number of men firing).

Consolidated record of individual firing.

Distance.	Company A.		Company B.		Company C.		Company E.		Engineer Battalion.	
	Number of men.	Per cent.	Number of men.	Per cent.	Number of men.	Per cent.	Number of men.	Per cent.	Number of men.	Per cent.
100 yards	41	75.95	37	78.85	43	77.75	42	82.52	163	78.78
200 yards	41	70.05	34	72.82	41	73.33	39	76.51	155	73.15
300 yards	41	63.86	33	68.61	41	70.24	38	76.94	153	69.84
400 yards	39	68.72	32	76.37	39	71.23	37	89.45	147	76.13
500 yards	38	61.20	26	76.00	37	72.11	......	....	101	69.01
600 yards	9	68.00	17	66.63	14	76.14	......	....	40	70.27
700 yards	......	....	7	76.57	......	....	......	....	7	76.57
Average	35	67.96	27	73.69	36	74.44	39	79.01	109	73.39

The firing of Company E was "necessarily suspended from about August 14 to September 10, 1880, at the request of the assistant surgeon of the post on account of the condition of patients in the post hospital, and finally stopped by order of the major-general commanding the department, on account of its interference with the operations of the railway construction parties."

The order of merit of the companies is therefore the following: Company C, Company B, Company A, Company E (score incomplete).

In volley firing the companies fired five times at each range, with the results stated in the following table. Company E did not fire by volley. Company C fired in a heavy rain storm.

Consolidated record of volley firing.

Distance.	Company A.		Company B.		Company C.		Company E.		Engineer Battalion.	
	Number of men.	Per cent. of maximum.	Number of men.	Per cent. of maximum.	Number of men.	Per cent. of maximum.	Number of men.	Per cent. of maximum.	Number of men.	Per cent. of maximum.
100 yards	11	90.55	14	84.57	24	84.00	......	....	49	85.61
200 yards	11	85.46	14	81.42	26	85.85	......	....	51	84.55
300 yards	11	79.64	14	66.85	25	80.00	......	....	50	76.24
Average	11	85.22	14	77.61	25	83.28	......	....	50	82.13

The copies of Colonel Laidley's Rifle Firing were received after the spring drills had commenced, and it was impracticable, without interfering with other matters, to carry out a full course of instruction in estimating distances at Willets Point. Hereafter this exercise will form part of the winter instruction. Company E (stationed at West Point) reported no drills in estimating distances; and the bad classification of that company in firing is explained above.

Classification of companies in firing and estimating distances.

Company.	Total number of men.	Number of men fired.	Firing.				Estimating distances.		
			Marksmen.	First class.	Second class.	Third class.	First class.	Second class.	Third class.
A	45	41	6	9	17	9	......	......	28
B	45	37	11	10	3	13	......	......	28
C	44	43	12	20	5	6	......	3	23
E	50	42	......	......	......	42	......	......	......
Battalion	194	163	29	39	25	70	......	3	79

MATCHES ENTERED AT CREEDMOOR.

At the fall meeting at Creedmoor, teams from Companies B and A, Battalion of Engineers, won the first and third prizes respectively in the "Short Range Military Team Match," and Company C stood seventh on the list of competing teams. The conditions of the match were as follows: "200 yards. Open to teams of five men from any company, troop, or battery of the National Guard of New York, or of other States, or of the Regular Army, Navy, or Marine Corps, to be composed of company officers, non-commissioned officers, or privates, certified to have been members of the company they represent on June 1, 1880. Position, standing. Rounds, seven. Teams to use the rifle their company is armed with." Twelve teams competed. The following tables show the scores made by the company teams in practice and in the match, which was shot on September 15. The day was rainy and unfavorable to good shooting.

COMPANY B, BATTALION OF ENGINEERS.

Name.	Rank.	Practice scores.			Scores in the match.		
		Points possible.	Points made.	Per cent.	Points possible.	Points made.	Per cent.
A. M. Miller	Captain	910	735	80.76	35	29	82.85
H. Von Schon	Private	945	767	81.16	35	28	80.00
C. Barrett	....do	945	782	82.75	35	31	88.57
W. Tracy	....do	945	738	78.09	35	28	80.00
A. Krebs	....do	420	348	82.85	35	29	82.85
Total		......	......	....	175	145	82.86

COMPANY A. BATTALION OF ENGINEERS.

Name.	Rank.	Practice scores.			Scores in the match.		
		Points possible.	Points made.	Per cent.	Points possible.	Points made.	Per cent.
James B. Quinn	Captain	980	784	80.00	35	29	82.86
Charles Renaud	First Sergeant	980	770	78.47	35	29	82.86
Theodore Royston	Sergeant	910	727	79.89	35	29	82.86
George Boyle	Private	980	754	76.94	35	26	74.29
Edward Kelly	Sergeant	980	753	76.84	35	24	68.57
F. V. Abbot	Second Lieutenant	770	585	75.98			
Nicholas Gentner	Sergeant	910	689	75.72			
Total					175	137	78.29

COMPANY C, BATTALION OF ENGINEERS.

Name.	Rank.	Practice scores.			Scores in the match.		
		Points possible.	Points made.	Per cent.	Points possible.	Points made.	Per cent.
J. C. Mallery	Captain	910	713	78.35	35	30	85.71
T. A. Bingham	Second Lieutenant	700	561	80.14	35	28	80.00
John Cavanagh	Private	910	730	80.22	35	26	74.28
Robert Kohrt	Private	910	740	81.32	35	25	71.43
William Reeker	Private	910	711	78.13	35	23	65.71
Total					175	132	77.43

This match has been shot yearly since 1876 and has been won by the following teams and scores. In 1876 a team from Company C, Battalion of Engineers, won the second prize with a score of 130 points, being but one point below the winning team.

Year.	Number of competing teams.	Winning team.	Scores in the match.		
			Points possible.	Points made.	Per cent.
1876	11	Company I, Seventh Regiment, N. G., S. N. Y	175	131	74.86
1877	13	Company B, Battalion of Engineers	175	127	72.57
1878	10	Company C, Battalion of Engineers	175	142	81.14
1879	8	Company C, Battalion of Engineers	175	133	76.00
1880	12	Company B, Battalion of Engineers	175	145	82.86

At the same meeting, a team from the Battalion competed in the Army and Navy Journal match, standing seventh on the list of nineteen competing teams. The conditions of this match were the following: "Open to teams of twelve from all regularly organized military organizations in the United States, including the Regular Army, Navy, and Marine Corps. All competitors to be regularly enlisted members, in good standing, of the regiment, battalion, corps, or troop they represent, and to have been such on June 1, 1880, and to appear in the uniform (full dress or fatigue) of the organization which they represent. Weapon, such military rifle as has been issued at the public expense to the organization which the team represents. Distance, 500 yards. Rounds, seven. Position, any, with head towards the target."

The following table shows the practice scores and those made in this match:

Name.	Rank.	Practice scores.			Scores in the match.		
		Points possible.	Points made.	Per cent.	Points possible.	Points made.	Per cent.
A. M. Miller	Captain	1,190	930	78.15	35	25	71.43
J. C. Mallery	do	1,225	950	77.55	35	27	77.14
Eugene Griffin	First lieutenant	420	349	83.09	35	21	60.00
T. A. Bingham	Second lieutenant	980	771	78.68	35	27	77.14
Charles Renaud	First sergeant	1,190	964	81.01	35	27	77.14
M. McCormack	Sergeant	1,260	974	77.30	35	24	68.57
M. Doolan	do	1,190	912	76.64	35	25	71.43
H. Von Schon	Corporal	1,225	932	76.08	35	31	88.57
C. Barrett	do	1,225	996	81.31	35	29	82.86
John Cavanagh	Private	1,260	995	78.97	35	29	82.86
Robert Kohrt	do	1,190	921	77.39	35	28	80.00
William Reeker	do	1,260	971	77.06	35	28	80.00
J. Turner	Sergeant	1,225	918	74.94	......	......	....
Theodore Royston	do	1,260	925	73.41	......	......	....
C. Von Sothen	do	1,260	946	75.08	......	......	....
J. Frazer	Private	1,120	841	75.09	......	......	....
Total					420	321	76.43

By order of Lieutenant-Colonel Abbot:

EUGENE GRIFFIN,
First Lieutenant of Engineers, Adjutant.

[General Orders No. 15.]

HEADQUARTERS BATTALION OF ENGINEERS,
Willets Point, New York Harbor, November 23, 1880.

I. Officers of the Battalion who have not already submitted the reports and papers required by General Orders No. 6, current series from these headquarters, will forward them as soon as possible, in order not to delay the publication of the usual general orders announcing the results of the summer's work.

II. The following will be the course of winter instruction for the Battalion during the ensuing season, beginning on the 1st proximo.

WILLETS POINT, NEW YORK HARBOR.

In the Torpedo Service.—A weekly detail, consisting of 3 officers, 1 non-commissioned officer, and 6 privates, will be made, as heretofore, for torpedo duty. The roster for enlisted men will be arranged by companies, in turn, and will include every enlisted soldier not excused by orders from these headquarters. The roster of officers will be arranged as follows: Officers who have served with the Battalion during the past season will form one roster, and those recently ordered for duty another. Details will be arranged to include two from the former and one (for two weeks) from the latter. Care will be taken to distribute the detail, so far as practicable, among the companies.

The officers will spend at least six hours daily in the laboratory (Sundays excepted). Weekly tours may be exchanged, in order to render applications for temporary absence unnecessary. It is expected that the officers will make themselves thoroughly familiar with the details of every part of our adopted system for submarine mining; with the practical execution of all the electrical measurements laid down in the proof sheets of the Torpedo Manual; and, generally, with the whole subject of torpedo defense, including its history, its mechanical details, its applications of electricity, the use of modern explosives, &c.

The enlisted men will spend the regular fatigue hours daily (Saturdays and Sundays excepted) at the laboratory or torpedo depot. Their instruction will be under the direction of the senior commissioned officer, aided by Sergeant W. H. Brown, assistant instructor in submarine mining. It will comprise telegraphing with the dial instrument, including the code for action; the duties of the loading-room, and, so far as practicable, of the boat service, as prescribed in the proof sheets of the Torpedo Manual, comprising preparing the plugs of the buoyant and ground torpedoes; charging the mines; charging the cut-off boxes, three methods; jointing the cores; making turk's heads in the electrical cable; using the junction boxes; attaching a cable stop; splicing and knotting hemp rope; inserting thimbles in the wire mooring rope. They will also receive from the senior officer *daily verbal instruction* respecting the fuses, explosives, torpedo material (except that of the operating room), voltaic batteries, simple electrical testing, and the use of the portable apparatus for the electrical ignition of mines. On the Saturday terminating his tour the senior officer will submit to these headquarters a report, giving the names of the detail, what *verbal* and other instruction they have received, figures showing the insulation of the core joints made by them, and their relative and absolute proficiency. Printed blank forms will be supplied.

In Field Photography.—The building, apparatus, chemicals, &c., are in charge of Captain Quinn, whose duty it is to furnish any desired assistance, and who will be held responsible for the judicious use of the property. Lieutenant Griffin, Battalion quartermaster, will act as his assistant in these duties.

Officers not on the following roster may, at their option, use the laboratory on Saturdays; making such arrangements with him as shall insure no confusion in his official duties.

Lieutenants on company duty will be placed on a roster for instruction or practice under Captain Quinn. Each tour will continue for two weeks, Saturday and Sunday excepted, and the details will be so arranged that one officer will be ordered weekly. This detail will excuse from all company duty, and the officer will spend at least six hours daily in the laboratory.

Officers who have already passed through the course of instruction are detailed for practice, and at the end of the season they will each submit a report specifying in detail the amount and quality of the work done by them.

The course of instruction will be arranged to cover that prescribed in General Order No. 2, series of 1877 from these headquarters; and at the close of the season each officer will submit, through Captain Quinn, a personal report upon the work he has accomplished. This paper will be returned to him, with indorsements, for his own files; and it is suggested that it be so prepared as to constitute part of the professional journal required by the Corps order regulating examinations for promotion.

Two non-commissioned officers from the companies, in turn, will be detailed for instruction for one week, Saturday and Sunday excepted. One will be selected from the following list:

Company A.—Sergeant Tiedmann, Corporal Wunder.
Company B.—Corporal Griffin, Corporal Von Schon.
Company C.—Sergeant Turner, Corporal Grenier.

The other will be taken in turn from the remaining non-commissioned officers of the company. Attendance will include the usual fatigue hours, and the instructor will prescribe such work as may be best suited for the individuals.

In Field Astronomy.—The daily observations of the officer of the day for time, and work in the observatory, after each officer has completed the course prescribed in General Order No. 6, current series from these headquarters, will be suspended during the inclement season.

In Meteorology.—The usual hourly meteorological observations at Willets Point will begin on January 2, 1881, and will continue for sixty consecutive days. Officers who have not already done so will take advantage of this opportunity to make themselves familiar with the contents of Professional Paper No. 15, of the Corps of Engineers, treating of meteorology and barometric hypsometry.

Captain Miller and Captain Mallery, each acting for ten days in turn, are charged with the supervision of these observations. They will make daily inspections of the instruments, and see that they are kept at all times in perfect condition. They will critically inspect the observer not less than once a day, ascertain by questions and by examining the plots and records that he understands and performs his duty, and, if necessary, will give him detailed instruction. At the end of each tour of ten days they will submit a report to these headquarters, giving the names of the several observers, the number of times each has been inspected, and a full statement of his relative and absolute proficiency.

The observers will consist of the lieutenants on company duty with the Battalion at this post, and of the requisite number of non-commissioned officers from each of the three companies, to be selected by the captains. Each tour will consist of two consecutive days; the observers will be excused from all other duty during that period, but will make all reductions and plotting pertaining to their records *correctly* and at *once*. Observations between the hours of 12 m. and 6 a. m., both inclusive, may be omitted. The roster of companies will be kept at these headquarters.

Immediately after the termination of the observations the data will be fully and intelligently discussed upon Colonel Williamson's system, by aid of the daily plots and diagrams, and under the supervision of the captains, by the lieutenants of the companies. To Company C is assigned the reduction of the observations with the psychrometer, including force of vapor and relative humidity; to Company A those with the aneroid barometer and of the air temperature; and to Company B those with the mercurial barometer, and of the winds and clouds. Should this reduction develop culpable want of accuracy on the part of any observer, his name will be reported by the captain in charge in transmitting the final tables and diagrams.

In Infantry.—Company commanders will see that their companies are kept well drilled in the manual of arms, and that they are practiced in the bayonet exercise, and when the weather is suitable in estimating distances. The hours of practice and of recruit drills will be regulated as may be most convenient. One company drill will be had at 3 p. m. on Friday of each week, recall being beaten at 2.30 p. m. for that purpose; the drill will be attended by all men supplied with muskets, except the foregoing details, and men actually on necessary duty which will not admit of delay.

Theoretical Instructions.—The non-commissioned officers of each company in turn will be detailed for one week for theoretical instruction. They will be excused from all duties but those necessary in the company, and will attend all recitations unless excused by the surgeon. The only exception to this detail will be the police sergeant, the depot sergeant, the acting drum major, the Battalion printer, and the Battalion photographer. The hours of the post school will be regulated accordingly when the teacher is on the detail.

Recitations will be conducted daily (Saturdays and Sundays excepted) at such hours as may be selected by company commanders. The latter will be the instructors of the companies, their subalterns being assistants. Regular classes will be formed in field fortification (including mining); pontoniering; topographical drawing; infantry tactics; the theoretical and practical use of the railroad transit; military signaling; and submarine mining according to the proof sheets of the three parts of the Manual. The instruction in electricity will include elaborate verbal explanations and experiments in the electrical laboratory, which will be open on Mondays and Tuesdays for this purpose.

Each recitation will be marked on the West Point system; and, at the close of each week, a list showing the marks of each non-commissioned officer, in each branch, will be forwarded to these headquarters.

During the winter season, the school for soldiers, ordered by act of Congress approved July 28, 1866, and announced to the Army in General Orders No. 56, dated War Department, A. G. O., August 1st, 1866, will be established. Attendance will be voluntary, the object being to extend aid to such enlisted men as desire to devote a portion of their winter's leisure to study. The necessary fuel for warming the rooms will be furnished by the Quartermaster's Department, as authorized by General Orders No. 94, series of 1867, from the headquarters of the Army.

This school will be under the charge of the Battalion adjutant. Sessions will be held between 7 and 8 p. m. on Tuesdays, Thursdays, and Fridays of each week. Weekly reports similar to those of the non-commissioned officers' recitations will be rendered to these headquarters.

WEST POINT, NEW YORK.

The drill of Company E being under the direction of the Superintendent of the Military Academy, it is requested that, as far as practicable, the non-commissioned officers and men may have instruction similar to that of the rest of the Battalion; and that a consolidated report of the recitations of the non-commissioned officers in each branch may be forwarded to those headquarters, at the close of the season.

By order of Lieutenant-Colonel Abbott:

EUGENE GRIFFIN,
First Lieutenant of Engineers, Adjutant.

[General Orders No. 2.]

HEADQUARTERS BATTALION OF ENGINEERS,
Willets Point, New York Harbor, January 3, 1881.

The following will be the military status and course of study of officers of Artillery ordered to report at Willets Point to qualify as acting Engineer officers in the duties of submarine mining.

MILITARY STATUS.

Such officers will be mustered on the field and staff rolls of the Battalion of Engineers, and will be borne on its reports and returns as on special duty. They will not be attached to companies nor be subject to ordinary details for military duty at the post, but will report themselves daily at headquarters immediately after guard-mounting, to enable the adjutant to make out the morning report correctly. They will attend reviews and inspections with the Battalion staff, and will be subject to the general orders and discipline of the post.

COURSE IN SUBMARINE MINING.

It is understood that all officers authorized to report for this duty do so upon their own application. The course of instruction will therefore be regulated: 1st, to afford, under a pledge of secrecy, every opportunity to become familiar with the drills, the apparatus and appliances, the library and the confidential publications of the school of submarine mining; 2d, to preserve, for the use of the Chief of Engineers and the General of the Army, such a record of individual proficiency as shall make known, the fitness of each officer to be detailed for duty in submarine mining in case of emergency. The course will, therefore, consist of daily reading, systematic laboratory practice, drills in submarine mining, followed by monthly examinations. Officers are expected spend six hours daily, except Saturdays and Sundays, at the laboratory, beginning immediately after guard-mounting.

This general course, which is similar to that upon which officers of the Battalion of Engineers are required to be examined for promotion, will be arranged as follows:

Month of January.—The first three chapters of Part I of the Manual, and a full course of laboratory practice in electricity and electrical measurement. Consult also: Electricity and Magnetism, by Jenkin; Reports on Electrical Standards, by Jenkin; Electricity and Magnetism, by Maxwell; Electricity applied to Arts, by St. Edme; Natural Philosophy, by Deschanel; Physical Technics, by Frick; Ganot's Physics; Physical measurements, by Kohlrausch; Telegraph Cable Tests, by Hoskiœr; Mémoriel des Officiers du Génie, especially vols. 17, 19, and 22; Electricity, by Sprague; Exposé de l'Electricité, by Du Moncel; Exercises in Electrical Measurements, by Day; Handbook of Electrical Testing, by Kemp; Pile Electrique, by Niaudet; Electricity and Magnetism, by Gordon; the files of the electrical journals of England, France, and the United States. See, also, other works named in the Catalogue of the Library under the heading, "Electricity and Magnetism."

Month of February.—Complete Part I, and study Parts II and III of the Manual, and General Abbot's Report upon Experiments and Investigations, made at Willets Point, to Develop our system of Submarine Mining—supplemented by use of the museum, and by laboratory practice in the mechanical details of loading torpedoes, making joints, inserting thimbles in wire rope, &c.

Month of March.—History of torpedo warfare, offensive and defensive, and study of foreign systems for the latter, so far as illustrated in the museum or known from publications. Consult: Johnson's Cyclopædia, art. "Torpedoes" (see scrap-book); Submarine Warfare, by Barnes; Torpedoes, by King; Coast Defense, chapter on Torpedoes, by Von Scheliha; Submarine Mines, by Stotherd; Review of same, by Dawson; Fabrication of iron for Defensive Purposes (article Torpedoes), by Board of Engineers; Torpedo Service in Europe in 1873 (in manuscript), by Casey and Abbot; Confidential Reports to British War Office on German and Austrian Torpedoes, by Chesney and Stotherd; Les Torpilles, by de Sarrepoint; Report de la Commission des Torpilles (Dutch), by Vandervelde; Lectures on Movable Torpedoes, Submarine Boats, and the Whitehead Torpedo, by Barber; Serial extracts from Engineering, 1876-'78; Torpedoes and Torpedo Warfare, by Sleeman; Minas Hidraulicas Defensivas (manuscript extracts translated by Lieutenant Abbot), by Scheidnagel; many articles in scrap-books. See, also, the Catalogue of the Library, under headings "Torpedoes" and "Articles on Torpedoes."

Month of April.—The subjects of modern explosives, and of the electric light as used in harbor defense—supplemented by experiments. Consult: La dynamite et La Nitroglycerine, by Champion; Les Dynamites, by Fritsch, in Mémorial de l'Officier du Génie vols. 20 and 22; Numerous Essays on Explosive Agents, by Abel; Dynamite Works of the Atlantic Giant Powder Company, by Mackenzie; Notes on Certain Explosive Agents, by Hill; Notes on Modern Explosives, by Abbot; Evidence before Circuit Court of Massachusetts, in Case of Atlantic Giant Powder Company *vs.* George M. Mowbray, 1876; Nitro-glycerine at Hoosac Tunnel, by Mowbray; Gun-cotton Explosion at Stowmarket, by Magendie; Lithofracteur, Report of Special Committee; Report of Select Committee on Explosive Substances; Researches on Explosive Substances—Fired Gunpowder—by Noble and Abel; see, also, Catalogue of Library for many articles on gun-cotton and other explosives, contained in the Journal of the United Service Institute and the Mémorial de l'Officier du Génie, and for other references. On the Electric Light, consult: Eclairage a l'Electricité, by Fontaine; Report of Committee of House of Commons on Lighting by Electricity; Electric Lighting, by Schoolbred; The Electric Light, by Higgs.

Months of May and June.—These months will be devoted to out-door drills and exercises, including the planting, testing, and raising of torpedoes, tracking vessels, practice in operating the apparatus for automatic and judgment firing, testing explosives in the rings, trials with the fish torpedo, and to a general review of the course.

EXAMINATIONS.

To determine the individual progress of the officers, an examining board, consisting of the lieutenant-colonel commanding, and of the three captains commanding companies, is hereby constituted.

On or about the last day of each month this board will assemble, upon the call of the president, to examine each officer on the course prescribed for the preceding month. The first five examinations will be oral, and the last one written. The object will be the official determination of absolute, not relative, proficiency; and no attempt at arranging a class standing will be made. The several examinations will be marked by each member, on the West Point system, and upon the completion of the course a report will be rendered through the Chief of Engineers to the General of the Army, setting forth the opinion of the board upon the qualifications and fitness of each officer to be detailed on submarine mining duty, in case it should become necessary to defend our coasts with torpedoes.

By order of Lieutenant-Colonel Abbot:

J. H. WILLARD,
First Lieutenant of Engineers, Adjutant.

[General Orders No. 3.]

HEADQUARTERS BATTALION OF ENGINEERS,
Willet's Point, New York Harbor, January 10, 1881.

The following are announced as the results of the astronomical observations taken in 1880 at the field observatory at Willett's Point (see General Orders No. 5 of 1870, No. 9 of 1871, No. 8 of 1872, No. 2 of 1873, No. 2 of 1874, No. 3 of 1875, No. 1 of 1876, No. 1 of 1877, No. 3 of 1878, No. 1 of 1879, and No. 3 of 1880, for former results).

Assronomical observations have been made at Willet's Point continuously since the establishment of the observatory—in 1869-'70-'71-'72, under the personal direction of the Battalion commander; in 1873-'74-'75-'76-'77, under the direction of the three company commanders, each acting for one week in turn; in 1878-'79, under the direction of Captain Miller; and in 1880, under the personal direction of the Battalion commander, assisted by Captain Mallery.

During these twelve years, 50 officers of the corps have had the benefit of practice with the instruments—the object being: 1st, to afford them, during their service with the Battalion, an opportunity to become entirely familiar with all the astronomical instruments and methods in use, both on first-class geodetic surveys and on reconnaissances; and, 2d, to accumulate numerical data for estimating the absolute errors likely to affect astronomical field-work, with instruments and methods of different grades of precision.

OLD OBSERVATORY.

The old observatory, constructed in 1868 with limited means and provided with inferior instruments, is sufficiently described in the first of the orders above named.

To determine its approximate geographical position, its location was laid down on a detailed survey of the public lands at Willet's Point, and forwarded in 1870 to Prof. J. C. Hilgard, assistant in charge of the Coast Survey office, who, from the latest determinations at that office, fixed its position:

North latitude, 40° 47′ 20″.52.
Longitude west from Greenwich, 4h. 55m. 06.04s.

In 1878, the latter determination was revised by time signals sent for ten consecutive days from the Naval Observatory at Washington (see General Order No. 1 of 1879) which gave the value now adopted:

West from Greenwich, 4h. 55m. 07.48s. ± 0.14.

The latitude, as deduced from all (65) observations with the zenith telescope—mostly made with an old instrument of the original pattern devised by Talcott, and depending on pairs of stars from the older catalogues—(see the General Orders above named) is:

North latitude, $40^\circ\ 47'\ 17''.66 \pm 0.575$.

NEW OBSERVATORY.

The old observatory was small and inconvenient in many respects, and a new one was erected by Engineer soldiers in the spring and summer of 1879. The instruments were transferred in September of that year. The center of the dome of the new building is 408 feet north and 210 feet west of the center of the only pier of the old building. At Willets Point, one second of latitude (arc) is about 101 feet, and one second of longitude (time), about 384 yards.

During the past year a careful determination of the latitude has been made with a fine zenith telescope and Safford's new catalogue of stars, prepared for the Wheeler Survey. The discussion of these observations, reported below, gives its position:

North latitude, 40° 47′ 21″.59 ± 0.082.

It will be noted that the latitudes determined at the two observatories, when transferred to a common point by the survey given above, differ only 11 feet. This result, depending on observations made by different observers with different instruments and star catalogues, at different places and in different years, is a fair test of the absolute precision of the method.

The longitude determined by the time signals from Washington in 1878, and transferred to the new dome by the survey above given, is—

West from Greenwich, 4h. 55m. 07.66s. ± 0.14.
East from Washington, 0h. 13m. 04.39s. ± 0.14.

The general arrangements of the new observatory have proved to be convenient in every respect; and the appended plate has been photolithographed on the battalion press, for the convenience of officers having occasion to construct field observatories of a semi-permanent character. It need only be added that the roof is of tin; that the sides of the meridian slits are prolonged upward to a horizontal plane, and are covered by a single hinged and overlapping shutter, manipulated from the roof—a plan which has perfectly excluded both rain and snow; that the vertical slits are closed by an external shutter and also by a window sash—the object of the latter being to reduce the opening to a minimum on windy nights, and to afford means of ventilating the building during hot summer days; and that the dome is revolved on four balls, by two fixed hand-levers engaging iron pins on its base.

An additional pier is provided outside the building, for practice with instruments to be placed in position on the night of observation.

A graded and graveled circle is arranged in the vicinity for sextant work. Officers recline or sit on a mat, as may be preferred; and the artificial horizon is required to be placed on the ground, as would be done in the field.

INSTRUMENTS.

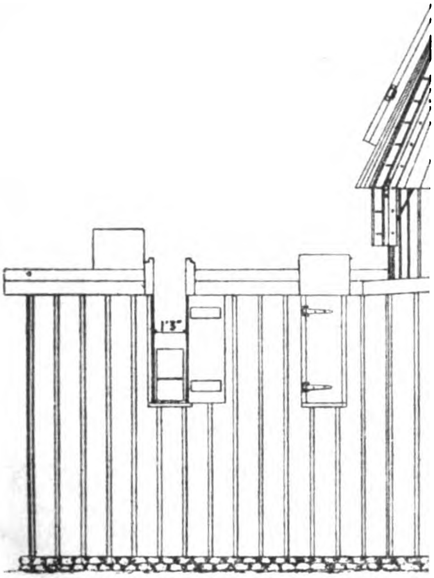
Equatorial telescope.—This instrument, ordered upon the following specifications from Fauth & Co., of Washington, in June, 1880, is now nearly ready for delivery.

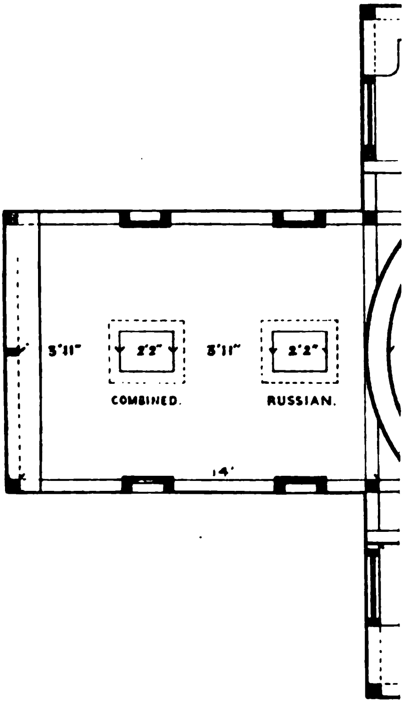
The object-glass is 5.5 inches in clear aperture, made by Alvan Clark & Sons, with a finder of 2 inches clear aperture. The principal eye-piece is fitted with a position micrometer of best construction divided on silver, with a parallactic movement, fine for spider-line and rapid for the entire box—as lately made in an instrument for Yale College observatory. Eight eye-pieces are supplied, three fitted to the micrometer. Both declination and hour circles are divided on silver, with an extra graduation (course) for approximate settings. They are respectively 12 and 15 inches in diameeter. The clock-work is governed by a Villarceau regulator, with maintaining power regulated from the eye end, and the declination axis is provided with a sliding level to bring the telescope into the meridian. The illumination is through the declination axis, the lamp being vertical in all portions of the telescope.

Portable telescope.—An old telescope made by Tulley, having an object-glass 3.8 inches clear aperture, and a focal length of 65 inches. It is equatorially mounted on a Smeaton's block, resting on a stiff tripod. Motion in right ascension and declination can be given by two handles within reach of the observer. The defining power of the telescope is fair, and there are several eye-pieces; but the vibration caused by the rough gearing of the moving parts renders it difficult to observe with a higher power than about fifty diameters.

Combined transit and zenith telescope.—This is a fine instrument (No. 2), made in 1876, by August Lingke & Co., at Freiberg, in Silesia. The clear aperture of its object glass is 2.5 inches and its focal length is 30 inches. It has two finding circles for transit work, and a larger circle and delicate level for use as a zenith telescope—all attached to the sides of the tube. The reticule contains fifteen fixed threads in three groups, and three fixed and one movable thread at right angles to them, for micrometer work. The eye piece has a rapid parallactic movement. The arrangement for revolving the instrument between the stops in latitude observations is solid and convenient. A horizontal tangent screw, with a micrometer screw adjusted to the azimuth V, renders it easy to place the instrument in the meridian.

Zenith telescope.—This fine instrument (No. 20) is one of the latest pattern, made by Wm. Wurdemann, of Washington, for the United States Northern Boundary Commis-


1'3"


3'11"
2'2"
3'11"
2'2"
COMBINED.
RUSSIAN.
14'

sion, in 1872-'73. The object-glass has a clear aperture of 2.6 inches, the focal length being 32 inches, and the magnifying power 60 diameters.

Russian transit —This instrument (No. 1666), also adapted for use as a zenith telescope, was made by Stackpole & Bro., of New York, after the pattern adopted for the American parties sent to observe the transit of Venus in 1874. In form it closely resembles a portable instrument made in 1870 for the Harvard College observatory by Mr. Herbst, the mechanician of the Pulkowa observatory in Russia; the addition of the level for zenith telescope work was due to Professor Winlock in 1873. The object-glass has a clear aperture of 2.6 inches, and a focal length of 30 inches. The image of the star is reflected at right angles to an eye-piece placed at one of the pivots, and thus unchanging in position. The instrument is characterized by great solidity, and combines several novelties of construction, notably that for reversal by a lever and carrier.

Troughton transit.—This is an old instrument, the first one ever purchased for the Military Academy at West Point, and is loaned to us by Professor Michie. It is simple and solid in construction, and is capable of excellent work, as may be seen by some of the following records. The object-glass has 2 inches clear aperture and a focal length of 30 inches.

Stackpole transit.—This is a light instrument, specially designed for mountain work and packed in a single box. It is used on the pier outside of the observatory, to afford practice in hurried adjustments. The clear aperture of its object-glass is 2 inches, the focal length being 24 inches.

Sextants.—There are two good sextants, both made by Stackpole & Bro., of New York. One of them has the recent addition of an attached level, for verifying the doubly reflected image of the star.

Chronometers, chronographs, &c.—Two good chronometers are on hand—one by Lukens, No. 141, and the other by Wm. Bond & Son, No. 217. Both have Negus' break circuit attachment for use with a chronograph. The former, an eight-day instrument, remains permanently in position on an offset from the pier of the equatorial. The other is portable. Both are rated to siderial time. For observations upon the sun, a mean solar chronometer by Arnold & Dent, No. 596, is available.

The only chronograph in use during the past season is of the Morse register pattern; but a Hipps' instrument has been purchased since the work ceased, and it will be available hereafter.

To abridge the practice necessary for estimating time correctly by the eye and ear method, and to detect individual peculiarities of observation, a personal equation machine, made upon their usual pattern, has been procured since the close of the season, from Fauth & Co., of Washington.

To determine the refraction affecting sextant work, a Green's cistern barometer an detached thermometer are provided.

OBSERVATIONS FOR LOCAL TIME.

Many observations both with astronomical transits and with sextants have been made at short intervals during the entire season.

With the transits.—The following observations were made to determine the value of a division of the levels used with the different transit instruments. These levels were attached firmly to the tube of the zenith telescope, and were measured in terms of the known micrometer turn.

Constants of transit levels.

Transit.	Observer.	Date.	Number of observations.	Value of a division of the level.
		1880.		Sec.
Troughton	C. McD. T	May 25	12	4.842 ± 0.099
Do	T. L. C	June 2	12	4.877 0.022
Do	T. L. C	July 21	12	4.946 0.021
Do	T. L. C	July 22	10	4.902 0.030
Do	T. L. C	July 22	12	4.989 0.009
Russian	C. McD. T	June 2	10	0.752 0.003
Do	T. L. C	July 21	12	0.800 0.007
Lingke	T. L. C	July 23	12	0.509 0.006
Stackpole	T. L. C	July 24	13	1.495 0.007
Do	J. L. L	June 2	10	1.869 0.004

Time has been noted by four methods: (A) by the recorder at the word "tick" given by the observer; (B) by the observer himself guided by the relay tick, which when the battery circuit includes the chronometer occurs at each second, and is as loud as the tick of an astronomical clock. The beat is picked up with the assistance of the recorder, who watches the face of the chronometer; (C) by the chronograph, using a a key which prints the record on the moving fillet of paper. This method is restricted to special observations; (D) by the usual eye and ear method, placing the Bond chronometer on the pier near the observer, who keeps his own record. Beginners use these several methods in succession, in the order named above.

The following observations were made to rate the standard chronometer (Lukens No. 141) during the working season.

Errors of standard chronometer.

Date.	Observer.	Transit instrument.	Time by method.	Number of stars.	Chronometer slow.		Remarks.
1880.					Sec.		
May 4	G. J. F	Troughton	A	9	70.90	± 0.15	
10	C. McD. T	do	A	5	67.31	0.11	
15	C. McD. T	do	A	8	64.71	0.20	
24	T. A. B	do	A	10	57.68	0.47	
25	T. A. B	do	A	9	55.66	0.39	
31	T. L. C	do	A	5	53.20	0.40	
June 3	T. L. C	do	A	13	51.19	9.14	
7	F. V. A	do	A	8	46.84	0.22	
9	J. L. L	Stackpole	A	9	46.42	0.11	Outer pier.
16	G. McC. D	do	A	8	42.84	0.10	do.
19	G. McC. D	Troughton	A	8	41.35	0.18	
20	W. L. F	Lingke	A	10	41.57	0.10	
22	J. L. L	do	A	14	41.31	0.07	Moon culmin.
29	E. G	Russian	A	11	41.91	0.00	
July 3	E. G	Lingke	A	7	43.68	0.00	
7	G. J. F	Troughton	B	8	44.90	0.20	
13	C. McD. T	do	B	8	50.15	0.07	
17	C. McD. T	do	B	11	52.21	0.06	
28	T. A. B	do	B	4	59.90	0.01	Clouds.
30	T. A. B	do	B	10	57.30	0.17	
Aug. 6	T. L. C	do	C	6	58.59	0.10	
9	F. V. A	do	B	19	61.47	0.07	
15	F. V. A	do	B	24	62.79	0.02	Moon culmin.
16	T. L. C	do	B	18	63.69	0.05	do.
20	C. McD. T	do	B	18	61.96	0.30	
Sept. 4	G. McC. D	do	B	8	64.34	0.08	
11	C. McD. T	Stackpole	A	11	66.23	0.14	Outer pier.
16	G. J. F	Troughton	B	10	66.75	0.17	Moon culmin.
17	T. A. B	do	B	16	64.70	0.05	do.
18	C. McD. T	do	B	17	65.14	0.06	do.
24	F. V. A	Stackpole	A	14	65.97	0.07	Outer pier.
25	F. V. A	Troughton	D	15	65.95	0.05	
28	T. L. C	Stackpole	A	13	67.17	0.09	Outer pier.
29	T. L. C	Troughton	D	16	64.33	0.04	
Oct. 9	G. McC. D	do	D	12	63.48	0.09	
10	G. J. F	Stackpole	A	13	64.54	0.07	Outer pier.
12	G. J. F	Troughton	B	8	64.40	0.26	
14	G. McC. D	do	D	17	62.17	0.05	Moon culmin.
15	G. J. F	do	D	20	63.71	0.04	do.
18	F. V. A.	do	D	22	61.23	0.01	do.
Nov. 11	T. A. B	Stackpole	A	12	70.38	0.38	Outer pier.
20	T. A. B	Troughton	D	12	77.99	0.15	
29	C. McD. T.	do	D	14	110.47	0.06	
Dec. 9	F. V. A	do	D	16	147.65	0.06	Moon culmin.

With sextant.—Many observations made for practice and by the officer of the day for regulating the post time are not reported. The following table includes those made in connection with sextant latitude and longitude observations.

Each officer is required to submit at least one complete set of observations for determining the latitude, by the method adopted by the Corps of Engineers for reconnaissances. Ten altitudes of an east and ten of a west star (both near the prime vertical and at similar altitudes) are taken for time; and corresponding sets on Polaris and on a south star at its culmination, for latitude—all made on the same night. By this method errors due to eccentricity and, if the sextant be carefully handled, to ill determined index error are both eliminated. No limit is fixed as to the number of trials, the object being to encourage that careful practice with the instrument which is so needful to attain skill in its use.

A set of similar observations for determining the longitude by the method of lunar distances is also required—chiefly for practice with the instrument, as the inherent inaccuracy of the method renders it of little use for land purposes.

Local time by sextant.

Initials of observer.	Date,	Names of stars.	No. of observations.	Chron. slow by sextant.		Chron. slow by transit record.	Error of sextant result.
				By each star.	Mean (slow).		
	1880.			M. Sec.	Sec.	Sec.	Sec.
W. L. F	June 23	α Cygni α Bootis	10 10	Defective. Defective.	84.6	41.5	43.1
G. McC. D	Oct. 7	Saturn α Lyræ	10 10	1 00.4 1 05.8	63.1	64.0	0.9
G. McC. D	Nov. 16	α Aurigæ Jupiter	11 7	1 09.0 1 06.1	67.6	73.5	5.9
J. L. L	June 24	East star West star	10 10	Not submitted.			
F. V. A	Sept. 23	β Pegasi α Lyræ	10 10	1 07.4 1 04.0	65.7	65.0	0.7
F. V. A	Oct. 8	α Tauri α Lyræ	15 15	1 02.7 1 03.3	63.0	64.0	1.0
F. V. A	Oct. 11	α Andromedæ α Lyræ	10 10	1 06.9 1 01.4	64.2	64.5	0.3
F. V. A	Nov. 11	α Tauri Jupiter	10 10	1 06.8 1 05.2	66.0	70.4	4.4
T. L. C	July 24	...... α Bootis	... 10	Defective. 0 55.1	55.1	55.0	0.1
T. L. C	July 27	Sun Sun	11 10	Mean solar chronometer.			
T. L. C	July 29	Sun	10	0 54.9	54.9	57.0	2.1
T. L. C	Sept. 30	Jupiter α Aquilæ	10 10	1 02.2 0 58.5	60.9	64.5	3.6
T. A. B	Nov. 12	α Tauri α Lyræ	10 10	1 28.0 1 00.3	74.2	71.0	3.2
T. A. B	Nov. 15	Saturn α Lyræ	10 10	Defective. 1 16.6	76.6	72.8	3.8
C. McD. T	Nov. 2	α Tauri α Cygni	12 11	1 04.8 1 06.3	65.6	65.5	0.1
C. McD. T	Nov. 16	α Lyræ α Aurigæ	11 10	1 07.3 1 09.6	68.4	73.5	5.1
G. J. F	Oct. 8	α Tauri α Lyræ	15 15	1 03.7 1 03.4	65.5	64.0	0.5
G. J. F	Nov. 11	α Tauri Jupiter	10 10	1 06.6 1 07.0	66.8	70.4	3.6

OBSERVATIONS FOR LATITUDE.

Observations for latitude have been made during the past year with the zenith telescope and with the sextant. The results by each instrument will be reported in turn.

With zenith telescope.—As this happened to be the first season with all the regular observers, work was confined to the simple zenith telescope. Next year the same officers will use the combined instrument and the Russian transit in determining latitude by this method. The following observations were made to find the instrumental constants:

Constants of zenith telescope.

Observer.	Date.	Turn of micrometer.			Date.	Division of level.		
		No. obs.	Value.			No. obs	Value.	
	1880.		″		1880.		″	
G. McC. D	Sept. 2	38	61.981	± 0.010	Dec. 2	16	0.919	± 0.001
F. V. A	Aug. 11	42	62.102	0.021	Nov. 26.	30	0.909	0.006
F. V. A	Oct. 7	42	62.058	0.032				
T. L. C.	Aug. 1	32	62.025	0.020	July 14	12	0.897	0.008
T, L C.	Aug. 22	80	62.021	0.010	July 17	14	0.909	0.005
T. A. B.	July 31	30	62.212	0.124	Dec. 1	20	0.918	0.005
C. McD. T.	Aug. 27	32	62.038	0.024	Nov. 27	20	0.924	0.004
G. J. F	Aug. 23	40	62.010	0.022	May 7	23	0.911	0.002
G, J. F					July 12	28	0.897	0.008
Means.			62.056	0.020			0.910	0.002

The Safford catalogue was used in selecting the pairs of stars for determining the latitude. Each officer prepared his own list, and observed on three nights as nearly consecutive as the weather permitted. The results are given in the following table, the latitude deduced by each officer appearing at the foot of his column—computed by the rule that no observation should be rejected: 1st, unless marked doubtful in the record book; 2d, unless giving a latitude at least 1 minute in error (which may fairly be attributed to mistaking one of the stars or to wrongly reading the micrometer); or 3d, unless rejected by Pierce's Criterion applied to his whole set of observations. Rejections for the first two reasons do not appear in the table, but their number (trifling) is reported at the end. Those for the last are entered, marked *.

Latitude by zenith telescope.

Pair Safford's catalogue.	Star class.	Initials of observers.						Mean of pair.	
		G. McC. D.	F. V. A.	T. L. C.	T. A. B.	C. McD. T.	G. J. F.	Weight.	Resulting latitude.
		″	″	″	″	″	″		° ′ ″
1250 1266	A B						22.01	0.73	40 47 22.10
1270 1293	AA B			22.25 *29.39				0.77	22.25
1297 1299	AA AA			25.92 20.28				1.65	23.10
1313 1335	A B			21.66 †25.10		21.44	20.89 21.08	1.88	21.27
1342 1351	A A			20.83 *†17.87		21.26	19.37 21.41 20.94	2.82	20.76
1366 1403	A A		21.88					0.82	21.88
1368 1389	B A			19.96 21.31 21.59				1.60	20.95
1396 1403	B A						*†37.94 20.97	0.73	20.97
1397 1406	AA A			22.09				0.84	22.09
1405 1424	A A		21.41					0.82	21.41
1416 1431	B A			22.88 23.32				1.25	22.85
1429 [illegible]	A B		[illegible]					0.73	22.74

Latitude by zenith telescope—Continued.

Pair Safford's catalogue.	Star class.	Initials of observers.						Mean of pair.	
		G. McC. D.	F. V. A.	T. L. C.	T. A. B.	C. McD. T.	G. J. F.	Weight.	Resulting latitude.
		″	″	″	″	″	″		° ′ ″
1445 1456	C A					20.89 18.83 20.50 18.56		1.19	19.70
1456 1458	A C		21.08	22.53			21.30 22.86	1.19	21.94
1464 1468	C B			21.47	20.67	18.41		0.97	20.26
1473 1495	A C		20.26 22.02					0.90	21.14
1483 1489	C B				19.74	20.06 20.71	22.98 *†27.82 22.95	1.12	21.29
1493 1499	A A			21.80 20.70				1.46	21.25
1498 1508	B A				*†—24.59 21.26	20.20 22.98 21.00 20.06		2.08	21.10
1511 1517	A A	23.52 23.59		21.69 21.41				2.40	21.55
1518 1526	C C		23 34 22.10					0.66	22.72
1518 1531	C A				19.84 26.06	27.37 16.59 19.55		1.27	21.88
1540 1541	B A	20.94 22.46						1.25	40 47 21.70
1549 1553	A A		20.52 21.68 24.16	22.29 23.31 23.65			20.90 *†36.99 21.15	3.55	22.21
1551 1565	A C				*†—12.00 20.23 20.93			0.90	20.58
1558 1569	B A	19.71 19.35						1.25	19.53
1560 1580	A C		21.77 22.76 21.81					1.08	22.11
1567 1572	B C				21.39			0.57	21.39
1583 1600	A A	19.97 22.12 16.31	19.03 21.19 20.00		15.98 18.50			3.55	19.14
1585 1619	B A			22.12				0.73	22.12
1594 1619	B A			21.13			20.01 21.75 *†17.51	1.60	20.96
1602 1636	C A				*†49.41 †28.93	22.10 22.67		0.90	22.39
1626 1629	B B	24.52 23.24 24.20						1.37	23.99
1629 1638	B A			21.90			21.11 23.46 21.83	1.60	21.61
1630 1638	A A		19.99 19.87 21.00					1.97	20.26
1640 1653	B B			23.73 23.59 23.12	22.90 *†—8.28	24.01 22.28	24.12 21.80 24.21	2.04	23.31

Latitude by zenith telescope—Continued.

Pair Safford's catalogue.	Star class.	Initials of observers.						Mean of pair.	
		G. McC. D.	F. V. A.	T. L. C.	T. A. B.	C. McD. T.	G. J. F.	Weight.	Resulting latitude.
		"	"	"	"	"	"		° ′ "
1645 1654	B C		22.10 22.10					0.82	22.10
1658 1678	A C	21.99 21.38 24.91	22.67	25.65 23.50 25.30				1.38	23.63
1667 1669	A A				20.88 21.75			1.46	21.06
1678 1691	C C					18.93 18.89		0.66	18.91
1684 1687	B AA	†25.78 24.25	20.42 21.19 20.39	22.82 21.96	21.30 21.70 20.93		20.91 22.80 19.68	3.26	40 47 21.39
1694 1702	A A	†24.88 †16.88 21.17	21.31 19.62 20.67		20.12			2.82	20.58
1698 1724	C C					21.99 20.39		0.66	21.19
1699 1707	C A						20.86	0.60	20.86
1699 1713	C A			22.37 20.92 21.27				1.08	21.52
1704 1713	B A	23.95 22.93		20.82 22.18			20.77	2.08	22.13
1712 1724	C C				19.02			0.49	19.02
1715 1724	B C			23.21		21.51 22.48		0.97	22.40
1732 1747	A A		21.43 22.23 20.36	21.96 21.32	22.00 21.18 21.02	22.78 21.71	20.10 21.76 20.42	4.35	21.41
1737 1754	AA A	20.61 21.15 †26.68						1.54	20.88
1751 1766	C A		23.79 23.07					0.90	23.48
1761 1772	B A	20.97 20.89 †17.79						1.25	20.93
1763 1781	A A			22.61 21.37	21.39		†24.31 21.09 21.20	2.82	21.53
1776 1801	A B					23.03 23.83		1.25	23.43
1777 1783	A B	†24.69 20.67 22.23	†19.64 21.29 20.24					1.88	21.11
1794 1800	A AA	†25.33 21.73 22.86			22.25 23.23		22.19 22.64 †20.68	3.44	22.46
1795 1801	A B		22.99 22.57 20.75					1.60	22.10
1802 119 G.	A			22.98				0.60	22.98
1807 1826	A B	22.16 22.39 22.10	†23.45 †21.21 22.62					1.88	40 47 22.32
1811 1821	B A					*33.92 *28.92			
1827 1835	A C			23.53 21.93	†14.54 21.31 19.10		21.59 20.34 21.37	1.38	21.31

Latitude by zenith telescope—Continued.

Pair. Safford's catalogue.	Star class.	Initials of observers.						Mean of pair.	
		G. McC. D.	F. V. A.	T. L. C.	T. A. B.	C. McD. T.	G. J. F.	Weight.	Resulting latitude.
		″	″	″	″	″	″		° ′ ″
1825 1856	A A					20.73		0.82	20.73
1838 1840	A B		20.45 19.05 20.49					1.60	20.00
1840 1846	B A	19.83 18.12 19 90						1.60	19.28
1848 1857	A A		23.38 22.30 21.47	23.53 24.21	*†− 8.80 19.87	20.47 18.07	21 14 20.11 22.13	4.08	21.52
1855 1863	B A	18.55 16.83						1.25	17.69
1861 1874	A B		19.31 24.47					1.25	21.89
1873 1875	B AA			21.86 21.23	†15.75 19.67 21.77	20.74 19.78	20.16 22.33	2.84	20.94
1882 1888	B B	20.45 17.09						1.10	18.77
1891 1899	A B		22.78 22.39	20.82	22.31 21.91	22.30 22.98	23.51 28.07 †24.30	2.61	22.69
1897 1906	C A	22.90 18.82 22.02						1.08	21.29
1907 1915	A B		22.21 21.32	24.11 22.65	†17.66 22.95	23.96 19 83	21.32 21.56 21.08	2.70	22.09
1915 1931	B A	20.53 21.25 21.95						1.60	21.24
1918 1933	A A		23.09 21.36	22.28 19.17	†33.03 †13.78	27.65 22.50	19.88 22.09 20.10	3.75	22.01
1935 1948	A A	20.78 22.14 18.35						1.97	20.42
1940 1951	A A				22.98 20.04	21.74		1.97	40 47 21.59
1944 1961	B B			22.20				0.69	22.20
1946 1948	A A		20.49 22.89					1.46	21.69
1957 1972	A B	†22.39 19.92 19.56			*†53.56 20.00	19.88		1.88	19.84
1976 2000	C C			23.01	21.16	20.94		0.75	21.70
1981 1985	A A	23.62 22.42	22.19 21.93					2.40	22.54
1990 1995	AA C		19.63 20.35					0.94	19.99
1998 2005	A A	23.95 20.22 24.70						1.97	22.96
2006 2015	C A		21.92 20.94					0.90	21.43
2006 2013	B A			21.52	23.71	23.39 22.73		1.88	22.84
Mean		21.58	21.53	22.34	21.03	21.58	21.61		See below.
Prob. error		±0.200	±0.103	±0.121	±0.335	±0.221	±0.116		
No. obs		61	65	57	43	46	54		
Wrong pairs.		2	3	0	1	8	4		

Different methods have been used in discussing these data, to deduce therefrom the most probable value of the latitude of the Observatory dome.

The grand mean of all the observations (340 in number) contained in the above table, is:

North latitude, 40° 47′ 21″.63.

The mean of all the observations (326 in number), throwing out those rejected by Peirce's Criterion, as applied by each officer to his entire work, and marked with (*) in the table, is:

North latitude, 40° 47′ 21″.66.

The mean of the means (84 in number) of each pair, after applying thereto Peirce's Criterion, and thus rejecting those marked (†) in the table, is:

North latitude, 40° 47′ 21″.46.

The grand mean of the 6 latitudes determined by the officers, is:

North latitude, 40° 47′ 21″.61.

The grand mean of the 6 latitudes determined by the officers, giving them weights inversely proportional to the squares of their mean errors, is:

North latitude, 40° 47′ 21″.73

Finally, the most elaborate discussion is the following. The mean of each pair, after applying Peirce's Criterion thereto, is given a weight shown in the ninth column of the table, and deduced by the usual formula:

$$P=\frac{n}{n\,(e_{,}^{2}+e_{,,}^{2})+4\,E^{2}}$$

In which P denotes the weight; n, the number of times the pair has been observed; $e_{,}$ $e_{,,}$ the probable errors in declination of the two stars as given in Safford's classification; and E the probable error of observation, given by the formula:

$$E^{2}=\frac{0.455\,\sigma\,\Delta^{2}}{N-N'}$$

In which Δ denotes the difference in latitude between each observed result and the mean result for that pair, and $\sigma\,\Delta^{2}$ denotes the sum of the squares of these quantities for the whole number of observations; N denotes the whole number of observations, in this case 326; and N′ the whole number of pairs, in this case 84. Usually E is found to be about ± 0.5; in the present instance it is ± 0.52.

The latitude thus derived from all the observations on the 84 pairs of stars, and to which every refinement of computation has been applied, is the following. It has been adopted as the nearest approximation to the true value.

North latitude, 40° 47′ 21′.59 ± 0.082.

With sextant.—The following table exhibits the latitude results submitted by each officer—the corresponding determinations of time having been already reported:

Latitude by sextant.

Observer.	Date.	Stars.	No. obs.	Latitude by sextant.		Error of sextant result.
				By each star.	Mean.	
	1880.			° ′ ″	° ′ ″	″
W. L. F	June 23	Polaris	10	40 47 29.3	40 47 26.0	4.4
		α Scorpii	13	22.7		
G. McC. D	Oct. 7	Polaris	12	40 47 08.0	40 47 21.7	0.1
		ε Pegasi	10	35.4		
J. L. L	June 24	Polaris	10			
		South Star	......	Not	submitted.	
F. V. A	Sept. 23	Polaris	10	40 47 25.5	40 47 20.0	1.6
		ε Pegasi	21	14.5		
F. V. A	Oct. 8	Polaris	15	19.8	19.8	1.8
		ε Pegasi	15	Defective.		
T. L. C	July 24	Polaris	10	40 47 18.6	40 47 22.3	0.7
		α Aquilæ	11	26.0		

Latitude by sextant—Continued.

Observer.	Date.	Stars.	No. obs.	Latitude by sextant.		Error of sextant result.
				By each star.	Mean.	
	1880.			° ′ ″	° ′ ″	″
T. L. C	July 27	Sun	6	19.5	19.5	2.1
T. L. C	Sept. 30	Polaris ε Pegasi	10 12	17 9 21.4	19.6	2.0
T. A. B	Nov. 15	Polaris α Pegasi	12 28	40 47 23.7 23.4	40 47 23.0	1.4
C. McD. T	Nov. 2	Polaris Jupiter	10 20	40 47 16.5 23.6	40 47 20.1	1.5
G. J. F	Oct. 8	Polaris α Pegasi	20 20	40 47 26.3 18.5	40 47 22.4	0.8

The methods heretofore in use have been the following—occultations by the dark limb of the moon, lunar culminations, eclipses of Jupiter's satellites and (chiefly for practice with the sextant) lunar distances; but as the arrangements in the new observatory were not entirely perfected, the first and third methods were not employed during the past season. Hereafter, the new equatorial will afford every desired facility.

Lunar culminations.—The American Ephemeris is used in reducing these observations. The computations receive the same care that would be given to them on a boundary survey. No observation is rejected unless noted as doubtful or thrown out by Peirce's Criterion. The mode of recording time on each date has already been reported in the general table giving the result of the transit work.

Longitude by lunar culminations.

Observers.	Date.	Stars.		Moon.			Longitude.	
		No.	Prob. error.	Limb.	No. wires.	Prob. error.	Computed.	Error.
	1880.		*Sec.*			*Sec.*	*h. m. sec.*	*Sec.*
G. McC. D	Oct. 14	17	0.04	I	5	0.12	4 55 17.32	9.66
J. L. L	June 22	14	0.07	Both.		Not submitted.		
F. V. A	Aug. 15	24	0.02	I	5	0.03	4 54 57.15	10.51
F. V. A	Dec. 9	16	0.04	I	5	0.13	55 02.25	5.41
T. L. C	Aug. 16	18	0.05	I	5	0.09	55 07.13	0.53
T. A. B	Sept. 17	16	0.05	I	5	0.04	55 04.78	2.88
C. McD. T	Aug. 20	18	0.30	II	4	0.19	55 00.74	6.92
G. J. F	Oct. 15	20	0.04	I	5	0.01	55 07.61	0.05

Lunar distances.—The method recommended by Professor Chauvenet is adopted in reducing these observations. The altitudes of the bodies are computed, observations being limited to measuring with a sextant the distance between the moon and one or more of the stars given in the ephemeris, and to determining the error of the chronometer by observing ten altitudes of an east and ten of a west star. The following table exhibits the longitudes submitted by each officer, no restriction being laid upon the number of trials. The corresponding times have been already reported with the other sextant work.

Longitude by lunar distances.

Observer.	Date.	Stars.	No. of Obs.	Longitude.	Error.
	1880.			*h. m. sec.*	*Sec.*
G. McC. D	Nov. 16	Jupiter	12	4 55 12.2	4.5
F. V. A	Oct. 11	Jupiter	16	54 54.6	13.1
F. V. A	Nov. 11	α Tauri	10	55 02.0	5.7
T. L. C	July 29	Sun Sun	6	55 14.1 55 09.6	6.4 1.9
T. A. B	Nov. 12	α Aquilæ	12	55 12.6	4.9
C. McD. T	Nov. 16	Jupiter	14	55 29 9	22.2
G. J. F	Nov. 11	α Tauri	10	55 49.1	41.4

AURORA BOREALIS.

The regular series of records of the displays of the aurora borealis, begun in 1870, has been continued, as heretofore. Three sentinel posts, widely separated from each other, are guarded nightly by soldiers of the Battalion of Engineers specially selected as watchmen. Eight men are thus permanently detailed. Three of them remain on duty from sunset to sunrise, and are required to report, when relieved, whether they have seen any auroral light during the night; and if not, whether the sky has been sufficiently clear to permit any to be visible. These records for the past year are presented in the following consolidated table—which, considering the difficulty of distinguishing the fainter displays, is regarded as establishing the trustworthy character of the record by the general accordance between the three independent observers. It appears that out of 216 favorable nights, 13 auroras were noted; and if we may assume the same ratio to apply to the clouded nights, about 22 auroral displays occurred durthe 12 months.

Auroral displays in 1880.

Name of month.	Auroras.				Clear nights.				Clouded nights.			
	Post No. 1.	Post No. 2.	Post No. 3.	Mean.	Post No. 1.	Post No. 2.	Post No. 3.	Mean.	Post No. 1.	Post No. 2.	Post No. 3.	Mean.
January	0	0	0	0.0	15	14	15	14.7	16	17	16	16.3
February	0	0	0	0.0	16	19	17	17.3	13	10	12	11.7
March	1	2	1	1.3	15	18	16	16.3	16	13	15	14.7
April	1	2	1	1.3	16	19	19	18.0	14	11	11	12.0
May	0	1	0	0.3	18	19	19	18.7	13	12	12	12.3
June	0	0	0	0.0	19	21	18	19.3	11	9	12	10.7
July	1	1	1	1.0	17	20	18	18.3	14	11	13	12.7
August	3	3	3	3.0	18	18	18	18.0	13	13	13	13.0
September	1	1	1	1.0	18	18	19	18.3	12	12	11	11.7
October	2	2	2	2.0	21	20	21	20.7	10	11	10	10.3
November	4	1	4	3.0	17	17	14	16.0	13	13	16	14.0
December	0	0	0	0.0	21	20	19	20.0	10	11	12	11.0
Total for year	13	13	13	12.9	211	223	213	215.6	155	143	153	150.4

Summary of auroral records for eleven years.

Year.	Clear sky.		Cloudy sky.		Total for year.	Remarks.
	Nights.	Observed auroras.	Nights.	Probable auroras.		
1870	184	50	150	41	99	Begun February 1, 1870.
1871	211	60	154	41	104	
1872	234	60	132	34	94	
1873	214	54	151	38	92	
1874	190	18	175	17	35	
1875	189	14	176	13	27	
1876	195	9	171	8	17	
1877	191	7	174	6	13	
1878	185	2	180	2	4	
1879	204	9	161	7	16	
1880	216	13	150	9	22	

These observations were undertaken to throw light upon the supposed connection between the number of solar spots and the frequency of auroras and of magnetic disturbances. They have now been continued long enough to give interest to the foregoing summary compiled from the general orders above cited. No corresponding record of solar spots during this period of eleven years is at hand for precise comparison; but such records have been preserved, and they show the number or spots in the year 1870 to be a maximum, and in 1878 a minimum. It will be noted that these years are nearly those of maximum and minimum observed auroras.

By order of Lieutenant-Colonel ABBOT.

J. H. WILLARD,
First Lieutenant of Engineers, Adjutant.

[Printed Orders, No. 4.]

BATTALION OF ENGINEERS.
Willets Point, New York Harbor, April 26, 1881.

The following will be the course of instruction and drills for the Battalion of Engineers during the coming season.

WILLETS POINT, NEW YORK HARBOR.

In Military Engineering.—1st. Verbal instruction by the company officers in the nomenclature and dimensions of the siege battery and model fronts of fortifications, including the reasons therefor. 2d. The completion of the model Vauban front in masonry, upon a scale of 1 inch to 1 foot. This drill will be under the charge of Lieutenant Willard, Battalion adjutant. 3d. A course of instruction in the molding room, including the making of modern siege batteries and saps upon a scale of 1:6. This drill will be by company, each in turn being entitled to the use of the room for one month. A commissioned officer of the company must always be present. 4th. A full course of trestle and wooden ponton drill, including boat maneuvers. For this drill the companies will be consolidated, two officers (a captain and lieutenant) being detailed by the Battalion adjutant, in turn. 5th. The construction and experimental breaking of a temporary wooden bridge over a dry ravine. 6th. Continuation of the experiments in preparing mine chambers for camouflets, by the explosion of small charges of dynamite. The shaft of the mines exploded in 1877 will be used for this purpose.

In the Torpedo Service.—As heretofore, practical instructions in the service of torpedoes will be given under special directions from these headquarters. A weekly detail of two commissioned officers will be made. Company commanders and Battalion staff officers will spend at least six hours, and lieutenants on company duty at least seven hours, daily on this duty. They will be excused from all other duties except dress-parades and inspections, and will be governed by General Orders No. 4, series of 1873, from these headquarters.

A weekly detail will be made of 1 non-commissioned officer from the Battalion, and of 6 privates from the companies in turn. These details will be so arranged as to include, in succession, every man in the Battalion not especially excused by the commanding officer.

During fatigue hours (except on Saturday and Sunday) the men will be under the orders of the senior commissioned officer of the torpedo detail, whose duty it is to see that, when not engaged in assisting in the torpedo trials now in progress, they are instructed (1) in the duties of the boat service, and (2) in those of the loading-room, as prescribed in the proof edition of the Manual.

The following system will be observed as closely as the weather permits:

1. *Planting single mines.*—One weekly drill will be had in planting and raising a buoyant mine; and another in planting and raising a ground mine of the model of 1873. The steam-launch will be used for this purpose.

2. *Placing the junction boxes.*—This drill will be simulated on land until the principles are fully understood by every member of the detail. It will then be executed in the river, using the base line between the fort and Engineer wharf. Care must be taken, by providing buoy ropes of sufficient length, to avoid the loss of anchors.

3 *Judgment torpedo drill.*—The mapping drill will first be practiced, then the judgment firing drill. The cat-boat Queen may be used if the weather be suitable; if not, use may be made of any passing steamer or sailing vessel. A few steamers should be racked at every drill.

4. *Automatic firing drill.*—This drill must first be practiced at the wharf, in the manner prescribed in the Manual. Subsequently, if desired by the officer in charge, it may be combined with the judgment drill on the river.

5. In unfavorable weather, the detail will be exercised in the duties of the loading-room, in the shore duties pertaining to the boat service, and in the use of the dial telegraph. The senior officer of the detail will also give verbal instruction respecting the fuzes, explosives, torpedo material—except that of the operating room—simple electrical testing, and the practical use of the ordinary forms of apparatus for the electrical ignition of mines. This can best be done in the torpedo museum, by reading and elaborating portions of the text of the Manual.

In giving this instruction, the senior officer of the torpedo detail will be aided by the junior officer. In their absence, Sergeant William H. Brown, Company A, assistant instructor in submarine mining, will be in general charge of the detail.

On the Saturday terminating his tour, the senior officer will submit to these headquarters the plots of the mapping drills, and a report giving the names of the detail, what they have been drilled in, and their relative and absolute proficiency. Printed blank forms will be supplied.

Before the end of the season, a grand group of mines will be planted and operated in the manner prescribed by the Manual, and trial runs will be made with the fish torpedo—under special instructions from the lieutenant-colonel commanding.

In military map-making.—Each lieutenant on company duty, who has not already done so, will make and plot a careful instrumental survey of one square mile of ground in the vicinity of the post, including contours laid down with a spirit level. He will be assisted in the field work by details of non-commissioned officers and privates from his company. The work will be plotted on a scale of 12 inches to the mile; and may be executed upon any recognized system preferred by the officer. The finished maps will be submitted to these headquarters on or before the termination of the drill season.

Each lieutenant on company duty who has not already done so, and each non-commissioned officer and five selected privates from each company, will make a satisfactory foot reconnaissance at least 5 miles long, in the vicinity of the post. The instructions laid down in General Orders No. 12, series of 1868, from these headquarters, will be strictly followed, including the contouring. Especial attention will be given to *making the scales correctly;* (1) no attempt being made to change the natural length of step in the field work; (2) the plot being made in terms of this natural unit; (3) its absolute length being determined carefully by pacing several times over a known distance; and (4) a correct scale being constructed from these data, with 100 yards as the unit, the zero being between the first and second divisions on the left, and the first division being subdivided into ten equal parts. The plot will distinctly show the *beginning and end of the reconnaissance,* without any attempt at compromising discrepancies.

The captains will be the instructors in these drills; and they will submit to these headquarters, *on or before the termination of the season,* the several maps and drawings—each duly approved by themselves.

A careful hydrographic survey of the shore of Throgg's Neck between the portions mapped in 1879 and 1880, will be made by the lieutenants on company duty not included in the last three paragraphs—the object being to determine the extent of encroachments upon the public lands by storms. This work will be under the direction of Lieutenant Willard, Battalion adjutant, who will be guided by verbal instructions from the lieutenant-colonel commanding.

In Field Photography.—The officers' laboratory will be open daily from 1.30 p. m. until 4 p. m. The building, apparatus, chemicals, &c., will be under the charge of Lieutenant Griffin, Battalion quartermaster, whose duty it is to furnish any desired assistance and who will be held responsible for the judicious use of the property.

Officers are invited to avail themselves of the advantages of the laboratory, making such arrangements with the officer in charge as shall insure no confusion in his official duties or in those of the men under his instruction.

The instruction of non-commissioned officers will be restricted to the following class selected from those who have displayed special aptitude during the winter course. They will be detailed singly for one week in turn and will receive such instruction as, in the judgment of the officer in charge, is best suited to perfect their knowledge of the subject.

Detail of Non-commissioned Officers.—Company A: Sergeant Tiedman, Corporal Wunder; Company B: Corporal Griffin, Corporal Von Schon; Company C: Sergeant Turner, Corporal Grenier.

In Field Astronomy.—The lieutenant-colonel commanding will continue in personal direction of the observatory. Captain Mallory will act in his absence and will supervise the computations, which must be submitted through him.

All the lieutenants who have not already completed the course and been excused from further observations will constitute the observers, a roster being kept by the adjutant. In addition, weather permitting, they will observe the sun or stars for time whenever serving as officer of the day. These observations will be computed at once and the error of the mean solar chronometer will be reported on the guard report at the end of the tour.

The following system will govern the observations at the observatory. The course covers two seasons, the first including sextant work and transit and zenith telescope work with the instruments in the east wing and on the outer pier; and the second including sextant work, practiced with the new combined instruments in the west wing and with the equatorial. Advantage will be taken of every suitable night for observing. Officers wishing to use the instruments for special observations or practice must apply for authority to do so.

Officers will usually be detailed for astronomical duty for one week in turn, but in case of bad weather the roster will be arranged so as to give each an equal chance to accomplish the work required of him early in the season; when this work is completed, and when in the judgment of the instructor he has become an expert observer, his name will removed from the roster.

Special note-books will be provided for each officer which, after the end of the season and inspection by the commanding officer, will become his personal property. Suitable blank forms will be printed both for observations and computations, and these forms will be pasted into the books, thus rendering them valuable for future reference.

The computations will receive special attention (1) as to methods employed, (2) as to the values adopted for the instrumental constants, and (3) as to rejection of doubtful observations. The latter is more than usually important because knowledge of the correct results is likely to bias the judgment. The following rules will be strictly observed. No correction of the original record is to be made subsequently; if clearly wrong, the observation must be rejected. No rejection of an observation is allowed unless (1) it was marked doubtful at the time, (2) it is thrown out by Peirce's criterion, or (3) its discrepancy is so largely in excess of any probable limit as to render some exceptional cause certain—for instance, a discrepancy of 1 minute in a zenith telescope latitude. Every rejection under this third case must receive the approval of the officer charged with supervising the computations.

The following allowance of time will be made for computations. Three days for a set of latitude observations with the sextant, for a set of time observations with the transit, for a longitude by Jupiter's satellites, for the value of a level division or for a micrometer turn with the zenith telescope; ten days for a longitude by moon culmination or by lunar distances, or by an occultation by the moon. These limits as to time must be strictly observed.

The following will be the ordinary routine of observations with the several instruments.

Sextant.—After becoming skillful in the use of this instrument upon the sun, observers will deduce at least one satisfactory latitude by observing a north and a south star, using the time deduced from an east and a west star, each based on ten altitudes taken on the same night. Finally, they will deduce one longitude by the method of lunar distances, computed by Chauvenet's method.

Transit.—A set of time observations for rating the chronometer will be made about once a week, observing a star above and a star below the pole for deviation, and about five south stars for time. Occasionally an observation on a slow circumpolar star will be made for determining the collimation constant. Every moon culmination occurring before 1 a. m. will be observed, until each officer has secured at least one satisfactory result.

At first, time will be recorded by the instructor; then the observer will take his own time; lastly, the field chronograph will be used.

Zenith Telescope.—Observers will first determine the level correction by daylight, using a distant terrestrial object. They will then find the value of a turn of the micrometer by observing on Polaris. Lastly, they will observe for latitude until they have obtained a satisfactory determination based upon not less than twenty pairs.

The Combined Transit and Zenith Telescopes.—These instruments will be used only after the observer has become thoroughly expert with the simpler forms, the object being to give familiarity with the latest special patterns in use by the Corps of Engineers.

Equatorial Telescope.—Every practicable occultation of a star of the sixth or higher magnitude by the dark limb of the moon, and every eclipse of Jupiter's satellites, will be observed either with this instrument or with an astronomical telescope, until each officer has obtained one satisfactory result. Suitable lists will be prepared in advance, so that no opportunity may be lost.

In Field Magnetic Observations.—This course also is for officers exclusivley; and, if practicable this season, will be carried out under special directions from these headquarters.

In Tidal and Current Measurements.—This course will comprise observations with the self-registering tide-gauge, with the electric current-meter, and with double floats. Lieutenant Willard, Battalion adjutant, is assigned to the charge of the work. He will be guided by special directions from the lieutenant-colonel commanding, and will apply for such details of lieutenants in turn, and enlisted men, as may be required.

In Infantry.—Instructions in the revised infantry tactics, including the school of the soldier, the company and the battalion, and in target practice according to a system based upon Laidley's Manual of Instructions in Rifle Firing, and defined in Battalion Orders Nos. 7 and 11, series of 1880.

A commissioned officer of the company must be present at and supervise all target practice, unless specially excepted by orders from the commanding officer of the post.

Captain Miller is assigned to the charge of the team which will be selected to represent the Battalion in the matches at Creedmoor during the coming season.

WEST POINT, NEW YORK.

The drill of Company E, stationed at West Point, being under the direction of the instructor of practical military engineering, it is desired that, as far as circumstances will permit, the men may receive instructions similar to that of the rest of the Battalion.

By order of Lieutenant-Colonel ABBOT: J. H. WILLARD,
First Lieutenant of Engineers, Adjutant.

[Printed Orders No. 5.]

BATTALION OF ENGINEERS,
Willets Point, New York Harbor, May 20, 1881.

The following is announced as the standing of the non-commissioned officers of the several companies of the Battalion, as determined by their recitations to their company officers during the past winter season:

	Pontoniering.		Field fort.		Infantry tactics.		Submarine mining.		Military signaling.		Surveying.	Topographical drawing.	Reconnaissance.
	Standing.	Average.	Standing.	Average.	Standing.	Average.	Standing.	Average.	Standing.	Average.	Standing.	Standing.	Standing.
COMPANY A.													
Sergeants.													
Renaud	8	9.75	7	9.33	7	9.40	5	9.77	7	9.40	4	2	4
Kelly	...	...	...	...	...	...	...	...	...	...	...	...	...
Royston	1	10.00	1	10.00	1	9.94	1	10.00	1	9.94	1	1	1
Gentner	2	10.00	3	9.91	3	9.80	4	9.82	3	9.80	6	8	5
Brown	5	9.92	4	9.94	4	9.66	2	10.00	4	9.66	2	4	3
Tiedman	7	9.83	6	9.86	6	9.46	6	9.66	6	9.46	5	7	7
Corporals.													
Kennedy	3	10.00	5	9.94	2	9.86	7	9.66	2	9.86	9	...	8
Wunder	4	10.00	2	10.00	5	9.66	3	9.85	5	9.66	3	3	2
Corcoran	6	9.92	8	9.26	9	8.53	8	9.66	9	8.53	7	5	6
Newman	9	9.42	9	8.80	8	8.93	9	9.40	8	8.93	8	6	9
COMPANY B.													
Sergeants.													
McKenna	1	10.00	1	9.58	1	9.80	5	9.71	4	9.85	5	2	2
Warford	4	9.93	7	8.91	4	9.40	6	9.71	6	9.73	3	...	...
McCormack	9	9.53	10	8.08	5	9.33	10	8.72	10	8.07	10	7	7
Doolan	5	9.86	2	9.08	2	9.60	3	9.76	3	9.92	4	5	5
Hutchinson	6	9.86	3	9.25	9	8.93	8	9.47	7	9.70	6	3	3
Lance Sergeants.													
Lees	11	9.40	11	7.75	11	8.33	9	8.76	8	9.33	9	...	...
Moore	...	...	...	...	...	...	...	...	...	...	...	8	8
Corporals.													
Warner	2	10.00	4	9.00	6	9.06	1	10.00	1	10.00	2	...	...
Henderson	3	10.00	5	9.00	7	9.00	...	...	...	...	...	6	6
Griffin	7	9.80	8	8.75	8	9.00	4	9.76	9	9.14	7	4	4
Von Schon	8	9.73	6	9.00	3	9.46	2	9.90	2	10.00	1	1	1
Barrett	10	9.53	9	8.16	10	8.73	7	9.52	5	9.81	8	...	...
COMPANY C.													
Sergeants.													
Bensen	1	10.00	1	9.92	4	9.89	1	9.93	...	...	...	3	2
Miller	2	10.00	6	9.66	7	9.78	4	9.87	8	...	6	1	5
Turner	3	10.00	3	9.83	5	9.89	6	9.83	1	...	2	2	4
Farley	8	9.50	4	9.78	8	9.73	8	9.73	7	...	8	7	7
Corporals.													
Boyle	7	9.83	8	9.33	3	9.93	7	9.83	3	...	3	5	1
Grenier	6	9.92	2	9.89	1	10.00	2	9.92	4	...	5	4	3
Newburg	4	10.00	5	9.67	2	10.00	3	9.92	5	...	1	6	6
Seymore	5	10.00	9	8.33	6	9.83	5	9.87	6	...	7	9	8
Lance Corporal.													
Robinson	9	9.20	7	9.58	9	9.00	9	7.11	2	...	4	8	9

	Pontoniering.		Field fort.		Infantry tactics.		Military engineering.		Topographical drawing.
	Standing.	Average.	Standing.	Average.	Standing.	Average.	Standing.	Average.	Standing.
COMPANY E.									
Sergeants.									
Marquart	1	10.00	5	9.83	1	10.00	6	9.94	6
Kierran	2	10.00	1	10.00	2	10.00	1	10.00	1
McEnany									
Patterson	3	10.00	2	10.00	3	10.00	2	10.00	5
Emerick	4	10.00	6	9.67	5	9.93	3	10.00	4
Corporals.									
Murphy	5	10.00	3	10.00	4	10.00	4	10.00	3
O'Connor									
Weber	6	9.75	4	10.00	6	9.75	5	10.00	2

By order of Lieutenant-Colonel Abbot:

J. H. WILLARD,
First Lieutenant of Engineers, Adjutant.

[Printed Orders No. 6.]

BATTALION OF ENGINEERS,
Willets Point, New York Harbor, June 14, 1881.

The following are announced as the results of the meteorological observations taken at Willets Point from January 2 to March 2, 1881. They form part of the regular series of which former results were announced in General Orders No. 13, of 1868; No. 6, of 1869; Nos. 1 and 8, of 1870; Nos. 4 and 6, of 1871; Nos. 3 and 7, of 1872; No. 3, of 1873; No. 5, of 1874; No. 5, of 1875; No. 6, of 1876; No. 3, of 1877; No. 6, of 1878; No. 4, of 1879; and No. 5, of 1880.

I. The observations were taken hourly from 7 a. m. until 11 p m., both inclusive, during 60 days (beginning at 7 a. m. on January 2). The observers were the lieutenants, the non-commissioned officers, and some of the privates of the Engineer Battalion.

The following table exhibits the horary corrections deduced from the arithmetical means of the hourly observations, corrected for temperature and reduced to level; the air temperature; the force of vapor; the relative humidity, and amount of clouds from 7 a. m. to 11 p. m., inclusive.

Maxima and minima points are indicated by the signs * and † respectively, which are placed so as to conform to the general sweep of the curves. The aneroid barometer was a pocket instrument by Cassella.

Midwinter horary corrections for 1881.

Hour.	Horary corrections.		Temperature, Fahr.	Psychrometer.		Amount of clouds.
	Mercurial barometer.	Aneroid barometer.		Form of vapor.	Relative humidity.	
	Inches.	*Inches.*	°	*Inches.*	*Inches.*	
7 a. m	−0.007	−0.001	23.50	0.097	0.674	4.83
8 a. m	−0.012	−0.010	23.94	0.101	0.686	4.66
9 a. m	−0.020	−0.021	24.81	0.100	0.663	4.60
10 a. m	*−0.023	*−0.026	25.97	0.109	0.679	4.91
11 a. m	−0.018	−0.022	27.48	0.111	0.661	4.80
12 noon	+0.001	−0.008	28.77	0.117	0.653	4.68
1 p. m	+0.021	+0.014	29.55	0.116	0.630	4.46
2 p. m	†+0.028	+0.025	30.23	0.120	0.626	4.63
3 p. m	+0.027	†+0.028	28.71	0.118	0.633	4.58
4 p. m	+0.023	+0.025	30.01	0.115	0.627	4.25

Midwinter horary corrections for 1881—Continued.

Hour.	Horay corrections.		Temperature, Fahr.	Psychrometer.		Amount of clouds.
	Mercurial barometer.	Aneroid barometer.		Form of vapor.	Relative humidity.	
	Inches.	*Inches.*	°	*Inches.*	*Inches.*	
5 p. m	+0.015	+0.020	28.99	0.114	0.647	4.38
6 p. m	+0.003	+0.007	27.64	0.109	0.644	4.23
7 p. m	—0.004	+0.001	26.97	0.109	0.677	4.10
8 p. m	—0.003	−0.007	26.69	0.106	0.655	4.11
9 p. m	—0.009	*—0.009	25.82	0.104	0.671	4.18
10 p. m	*—0.011	—0.006	25.66	0.105	0.681	4.23
11 p. m	—0.009	—0.005	25.28	0.100	0.654	4.26
Means	30.007	29.623	27.06	0.108	0.656	

The extremes of air temperature during the hours of continuous observations for the sixty days were +50° Fahr. (February 28, 1 p. m.) and —2° Fahr. (February 2, 7 a. m). The lowest temperature recorded by the minimum thermometer was —3° Fahr., noted on the night of February 1-2.

The extremes of the hourly barometric readings reduced to 32° Fahr. were 30.698 on February 7, 8 a. m., and 29.164 on January 21, 2 p. m.

The following table exhibits the force and direction of the prevailing winds, recorded upon the usual scale, 0 representing a calm and 10 a hurricane. The table is computed—for force, by dividing the sum of the hourly records of force for each point of the compass by the number of hours during which the wind blew from that direction; and for direction, by giving the number of hours during which the wind held from each point of the compass.

	N.	N. E.	E.	S. E.	S.	S. W.	W.	N. W.	Calm.
Hours	91	172	30	30	22	61	157	269	186
Mean force	2.31	1.79	2.57	2.47	2.23	2.43	2.66	2.61	....

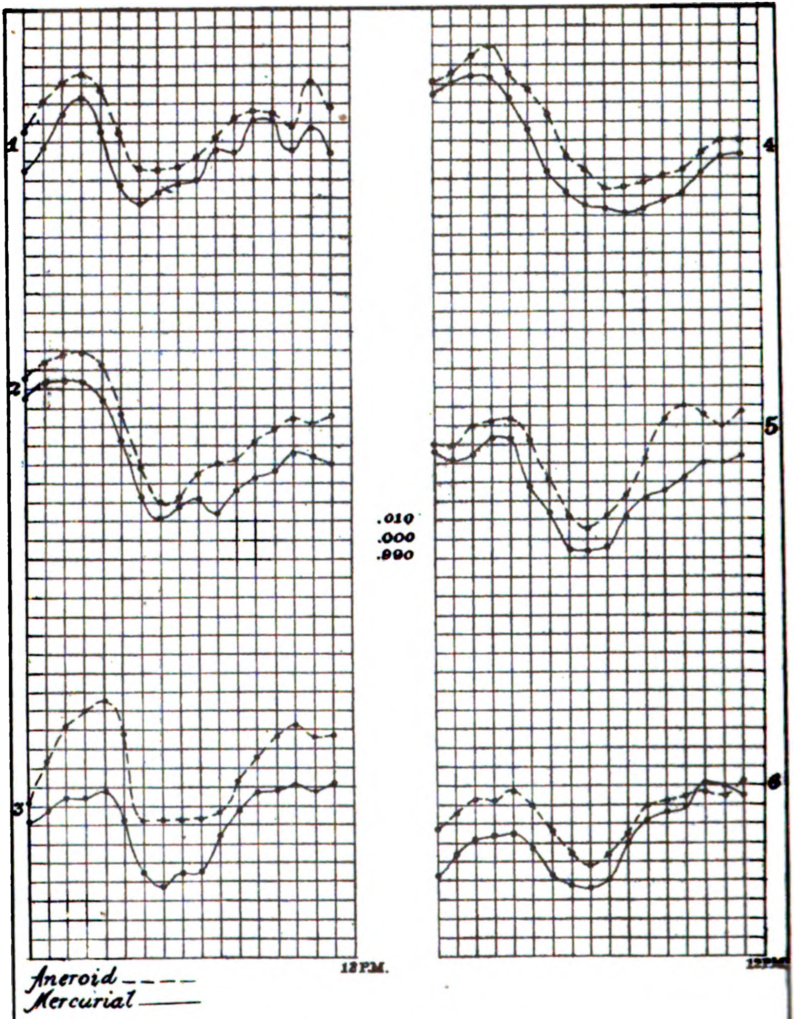
II. The discussion of the observations with the aneroid barometer, assigned to Company A, was made by Lieutenants Abbot and Goethals. In addition to the required work, they analyzed the horary curves separately for each ten days, comparing the results obtained by Colonel Williamson's method with those given without the reduction to level. The former, which, as usual, were smoother and more normal curves, are shown in the following table:

Ten-day horary curves, aneroid barometer.

Hour.	First ten days.	Second ten days.	Third ten days.	Fourth ten days.	Fifth ten days.	Sixth ten days.
7 a. m	−0.001	−0.001	−0.001	−0.001	−0.001	−0.001
8 a. m	−0.019	−0.010	−0.018	−0.005	−0.000	−0.009
9 a. m	−0.030	−0.018	−0.036	−0.013	−0.013	−0.015
10 a. m	−0.038	−0.027	−0.036	−0.020	−0.015	−0.020
11 a. m	−0.030	−0.013	−0.045	−0.010	−0.017	−0.015
12 noon	−0.008	+0.008	−0.023	−0.001	−0.005	−0.015
1 p. m	±0.000	+0.036	+0.003	+0.023	+0.017	+0.007
2 p. m	+0.012	+0.043	+0.016	+0.036	+0.035	+0.009
3 p. m	+0.011	+0.041	+0.017	+0.041	+0.042	+0.016
4 p. m	+0.005	+0.033	+0.019	+0.053	+0.032	+0.012
5 p. m	−0.008	+0.037	+0.015	+0.054	+0.023	−0.015
6 p. m	−0.018	+0.025	+0.009	+0.044	+0.004	−0.018
7 p. m	−0.023	+0.011	+0.001	+0.047	−0.010	−0.024
8 p. m	−0.022	−0.007	−0.007	+0.042	−0.024	−0.021
9 p. m	−0.023	+0.001	−0.009	+0.031	−0.030	−0.028
10 p. m	−0.018	+0.005	−0.004	+0.027	−0.015	−0.026
11 p. m	−0.017	+0.011	−0.002	+0.020	−0.017	−0.022

To test the absolute accuracy of the aneroid as compared with the mercurial cistern-barometer, the observations for each ten days were grouped in horary curves, no cor-

Plate A.



COMPARISON,
of the
ANEROID and MERCURIAL
BAROMETERS.

rections of any kind being applied except to reduce the readings of the mercurial barometer to 32° Fahr. This analysis, shown by appended plate A, established a close general accordance between the two instruments, and detected neglect on the part of a few of the observers to tap the aneroid before taking the reading.

The index error of the aneroid barometer was +0.386, varying but slightly for the whole series of observations. It is ignored upon the plate, the object being simply to show the degree of parallelism between the curves.

The following extracts from the report of this analysis give all needful details:

"*First and second ten days.*—The curves of the two barometers were essentially parallel, the maximum divergence occurring in both cases at 11 p. m.

"*Third ten days.*—A large discrepancy is seen. The aneroid curve exaggerates the maxima and omits the minimum. A series of rapid abnormal oscillations occurred at this time. When the aneroid was read without previous tapping, the daily plots indicate a tendency to stick at the same reading if the barometer be falling; no such tendency appears with a rising barometer. All errors in the mean curve are thus algebraically 'in excess.'

"*Fourth ten days.*—Close agreement, no sticking apparent in separate days' observations.

"*Fifth ten days.*—Another excessive maximum in the aneroid curve, due to the same cause as above.

"*Sixth ten days.*—The discrepancies in these curves are due to the careless reading of both instruments by two of the observers—which vitiated four of the daily records."

III. A valuable set of observations was projected and taken by Lieutenant Casey in December, 1880, to test the degree of accuracy attainable near the sea level when, as is often the case, it becomes desirable to determine a horary barometric curve from a limited number of observations.

For eleven consecutive days and nights (December 6 to December 16) he took hourly observations with a Green's cistern barometer in good condition, the vernier reading by estimation to 0.001 of an inch. The work was done with great care, without assistance, and with the omission of only four hourly readings on five nights—thus eliminating the effect of personal equation, and yet including the whole twenty-four hours in the discussion.

The records, when analyzed by Colonel Williamson's method, indicated that excessive abnormal oscillations on the 6th, 8th, and 14th so modified the form of the horary curve that those days should be thrown out. The others gave good results, as shown in the following tables—interpolations in parentheses.

Daily horary curves, December, 1880.

Hour.	December 6.	December 7.	December 8.	December 9.	December 10.	December 11.
7 a. m	—.035	+.029	—.133	—.008	—.001	—.017
8 a. m	—.036	+.022	—.124	—.020	—.015	—.030
9 a. m	—.053	+.011	—.107	—.028	—.035	—.052
10 a. m	—.068	+.009	—.083	—.036	—.036	—.056
11 a. m	—.046	+.008	—.036	—.020	—.031	—.036
12 m	—.038	+.030	+.033	—.008	—.007	—.030
1 p. m	+.003	+.037	+.088	+.012	+.002	—.014
2 p. m	+.027	+.055	+.122	+.027	+.015	—.006
3 p. m	+.056	+.049	+.133	+.024	+.014	+.004
4 p. m	+.017	+.040	+.132	+.026	+.030	+.016
5 p. m	±.000	+.013	+.101	+.024	+.024	+.029
6 p. m	+.021	—.006	+.080	+.010	+.016	+.013
7 p. m	+.035	—.026	+.054	+.004	+.009	+.005
8 p. m	+.031	—.038	+.030	—.003	—.001	+.018
9 p. m	+.017	—.047	+.001	—.008	—.006	+.020
10 p. m	+.013	—.032	—.019	—.010	—.008	+.022
11 p. m	+.031	—.033	—.042	—.001	+.010	+.027
12 p. m	+.029	—.033	—.048	+.009	+.011	+.027
1 a. m	+.025	—.028	—.066	+.007	+.009	+.022
2 a. m	(+.014)	—.028	(—.077)	+.008	(+.007)	+.022
3 a. m	(+.003)	—.024	(—.088)	+.004	(+.006)	+.018
4 a. m	(—.008)	—.021	(—.099)	+.001	(+.005)	+.014
5 a. m	(—.019)	—.005	(—.109)	+.003	(+.004)	+.004
6 a. m	—.030	+.004	—.119	—.009	+.003	—.010

Daily horary curves, December, 1880—Continued.

Hour.	December 12.	December 13.	December 14.	December 15.	December 16.	Grand mean.	True mean.
7 a. m	—.013	—.040	—.072	+.012	—.016	—.027	—.007
8 a. m	—.019	—.036	—.091	+.005	—.016	*—.033	—.014
9 a. m	—.032	—.032	—.112	—.014	—.022	—.043	—.025
10 a. m	—.033	—.027	—.127	—.009	—.027	—.045	*—.027
11 a. m	—.021	—.006	—.114	—.006	—.016	—.029	—.016
12 m	—.006	+.019	—.089	+.011	+.011	—.007	+.002
1 p. m	+.016	+.040	—.071	+.034	+.018	+.015	+.018
2 p. m	+.012	+.048	—.049	+.030	+.034	+.029	+.027
3 p. m	+.032	+.051	—.013	+.038	+.027	+.038	†+.030
4 p. m	+.018	+.046	+.010	+.016	+.020	+.033	+.026
5 p. m	+.019	+.038	+.021	+.014	+.028	+.028	+.023
6 p. m	+,011	+.023	+.038	—.002	+.012	+.020	+.010
7 p. m	+.011	+.016	+.079	—.009	+.004	+.017	+.002
8 p. m	+.008	+.011	+.082	—.022	—.010	+.010	—.004
9 p. m	—.001	+.003	+.113	—.020	—.014	+.005	—.009
10 p. m	—.005	+.001	+.115	—.021	—.009	+.004	*—.006
11 p. m	— 009	—.010	+.110	—.024	—.010	+.004	—.006
12 p m	—.005	—.016	+.108	—.016	—.009	+.005	—.004
1 a. m	+.007	—.010	+.095	—.013	—.008	+.004	—.002
2 a. m	(+.007)	—.022	(+.068)	—.008	—.005	—.001	—.002
3 a. m	(+.007)	—.031	(+.041)	—.009	—.005	—.007	—.004
4 a. m	(+.008)	—.029	(+.014)	+.001	±.000	—.010	†—.003
5 a. m	(+.008)	—.023	(—.013)	±.000	+.007	—.013	±.000
6 a. m	+.008	—.023	—.040	+.006	+.002	—.019	—.002

When plotted, these curves, with the exceptions above noted, show unmistakable parallelism; and the final mean (Plate B) is undoubtedly the true normal form for this season—compare similar curves for January 28 to February 8, 1869, observed at Willets Point and Albany, and published in General Order No. 6, series of 1869, from headquarters Battalion of Engineers; also similiar midwinter curves (observations continued for the whole twenty-four hours) for 1870, 1872, and 1873.

By order of Lieutenant-Colonel Abbot:

J. H. WILLARD,
First Lieutenant of Engineers, Adjutant.

[Printed orders, No. 7.]

BATTALION OF ENGINEERS,
Willets Point, New York Harbor, July 14, 1881.

General Orders No. 86, A. G. O., series of 1879, prescribing the new system of target practice for the Army, does not revoke existing orders authorizing the appointment of company and regimental prizemen, upon the conditions laid down in the old system.

The results of this competition for the Battalion and company prizes for the year ending June 30, 1882, are accordingly announced—the following being a list of the strings in ten shots, fired standing at 200 yards, in the competition for the Battalion prize:

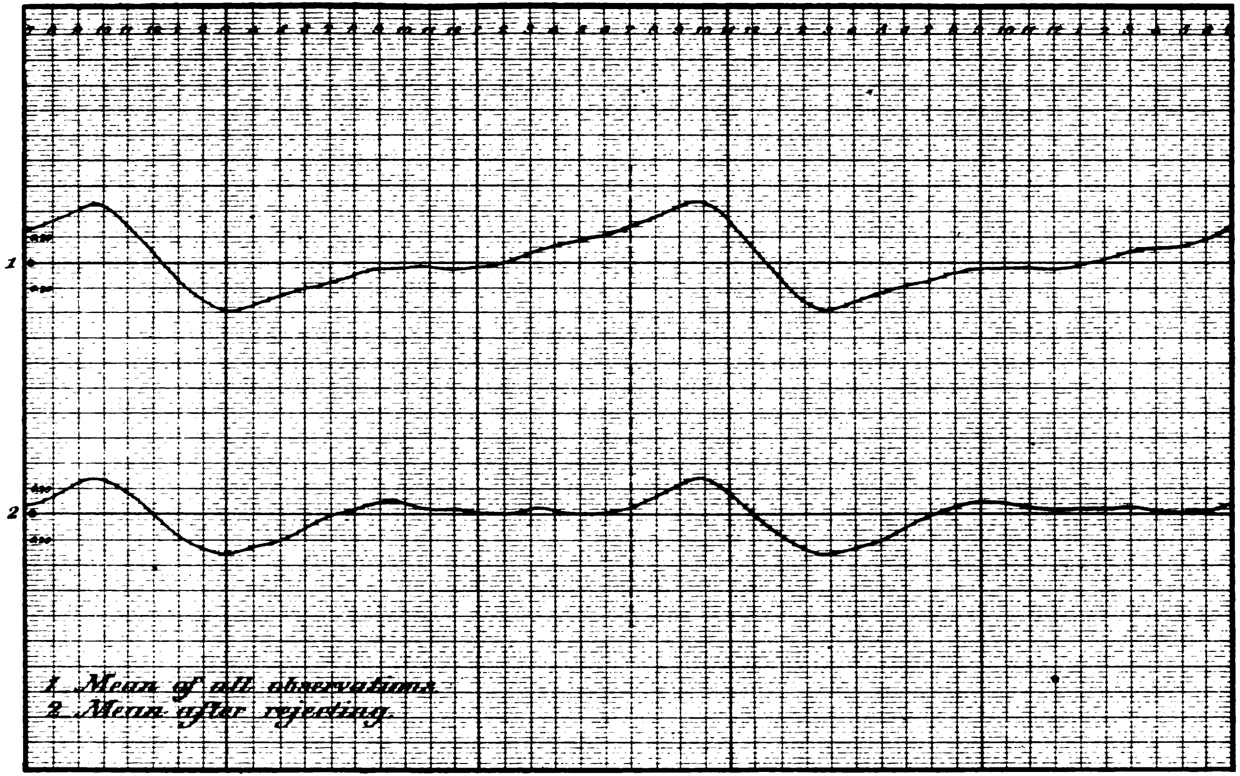
Company A prizeman, Sergeant Theodore Royston, 103.31 inches.
Company B prizeman, Second-class Private Albin Krebs, 109.93 inches.
Company C prizeman, First-class Private John Cavanagh, 124.25 inches.
Company E prizeman, Corporal John F. Weber, 86.93 inches.

Corporal John F. Weber, Company E, is accordingly announced as Battalion prizeman for the year ending June 30, 1882; he will receive the silver stadia from the hands of the commanding officer of Company E at the parade when this order is published.

By order of Lieutenant-Colonel Abbot:

J. H. WILLARD,
First Lieutenant of Engineers, Adjutant.

Plate B.



APPENDIX No. 4.

ENGINEER DEPOT AND POST OF WILLETS POINT.

REPORT OF LIEUT. COL. H. L. ABBOT, CORPS OF ENGINEERS, BVT. BRIG. GEN., U. S. A., OFFICER IN COMMAND FOR THE FISCAL YEAR ENDING JUNE 30, 1881.

WILLETS POINT, NEW YORK HARBOR,
July 6, 1881.

GENERAL: I have the honor to submit the following as my annual report upon the Engineer Depot and Post of Willets Point for the fiscal year ending June 30, 1881:

PUBLIC BUILDINGS.

The new building for officers' quarters, mentioned in my last annual report, was completed, and has been occupied during the winter and spring. The total cost, including the house itself, the out-buildings, and 700 feet of drains, has been $9,538.72, of which $9,000 was supplied by the Quartermaster's Department and $538.72 was paid from the appropriation for the depot. The work was done under my personal direction, by my assistant engineer and general foreman, the bills being paid by the post quartermaster. The house will comfortably accommodate six unmarried officers, and in case of necessity can be occupied by more.

A great deal of work in reshingling the barracks, renewing outbuildings of officers' quarters, &c., has been done by the troops, without expense to the government, except for the materials, which have been supplied by the Quartermaster's Department.

THE DEPOT STORAGE, RECEIPTS, ISSUES, &C.

As heretofore, the property has been guarded, cared for, received, and issued by the Engineer Battalion. No change has occurred in any of these details as reported in former annual reports.

The use of chloride of calcium for drying the air of the two rooms used for the storage of instruments (capacity 37,000 cubic feet) has been continued with entire success, the results being as given in the following table:

Drying by calcium chloride.

Date.	Weight of solution.	Weight of anhydrous salt.	Difference.	Amount of water, in gallons.	Remarks.
1880.	*Pounds.*	*Pounds.*	*Pounds.*	*Gallons.*	
July 29	273	161	112	13.4	Boiled, on an averge, six hours; fuel, wood; specific gravity, 1,400.
September 3	255	148	107	11.6	
September 27	297	183	114	13.6	
November 3	212	101	111	13.2	
1881.					
May 28	255	166	89	10.6	
June 9	170	67	103	12.3	
Total	1,462	826	636	74.7	

The remodeling of the bridge equipage in store by skilled labor of the Battalion has continued as heretofore. Seven chess wagons have been remodeled at trifling cost, to conform to the new pattern; the material of 10 old wagons has been largely made use of in this work, and the new wagons are as serviceable as could be purchased in New York for $300 each. The labor is very considerable, but has cost, in extra-duty pay, only the following sum for the 7 wagons:

1 enlisted man, carpenter, 161 days, at 35 cents	$56 35
1 enlisted man, blacksmith, 101 days, at 35 cents	35 35
1 enlisted man, helper, 96 days, at 20 cents	19 20
Total for 7 wagons	110 90

The printing-office has been busy during the entire year in printing confidential Engineer documents. Three soldiers of the Battalion have done this work, at a total cost for extra-duty pay of $271.25.

The receiving and issuing of instruments for the general use of the Corps of Engineers, with the repairs incidental thereto, have been continued. Fifty-four instruments have been received and 133 issued, as per appended list, marked A. The apparent falling off in these numbers is explained by the fact that the supply on hand has been quite insufficient for the demand.

STATEMENT OF FUNDS.

Congress appropriated the sum of $5,000 for the past fiscal year, of which $4,000 were for current expenses and $1,000 for the instruction of the Engineer troops. The following is a summary statement of these funds:

Expended during fiscal year 1880-'81	$4,608 78
On hand, due for fiscal year 1880-'81	391 22
Available for fiscal year 1881-'82	5,000 00
Desired for fiscal year 1882-'83	10,000 00

In explanation of the last item I would submit the following:

The usual annual appropriation for the purchase of materials for the instruction of the three companies of the Battalion of Engineers stationed at Willets Point, in their duties as sappers, miners, and pontoniers, viz, $1,000.

The usual annual appropriation for the incidental expenses of the depot, viz: Fuel, forage, chemicals, stationery, extra-duty pay for soldiers employed in wheelwright work, engine driving, printing, binding, photographing or lithographing Engineer documents, &c.; ordinary repairs of public buildings; repairs of instruments, &c., $4,000.

For public buildings for the Engineer school of application. The torpedo laboratory and the field observatory are now completed; the photographic laboratory, for instruction in duplicating military maps in the field, and the moulding-room, for instruction in field fortification on a reduced scale, suited to the present strength of the companies, are both entirely too small for their objects. They are old buildings, built during the war for hospital uses, and should be replaced by plain structures of minimum cost, but serviceable. For this purpose an appropriation of about $8,000 will probably be required; but as the work can be done more economically if not hurried, only the sum of $5,000 is requested for the coming fiscal year.

Very respectfully, your obedient servant,

HENRY L. ABBOT,
Lieutenant-Colonel of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U S. A.

A.

Statement of receipts and issues of instruments from the Engineer Depot, Willets Point, New York Harbor, for 1880-'81.

List of articles.	Received.	Issued.	List of articles.	Received.	Issued.
ASTRONOMICAL.			RECONNOITERING.		
Astronomical transits ......number..	......	1	Spy-glasses, large..........number..	......	1
Chronometers ....do	2	6	Spy-glasses, small ....do	......	1
Relays, magnets, sounders, and keys, set	......	1	Binocular field-glasses.........do	......	2
			Odometers.........................do	2	9
Artificial horizons..........number..	1	.....	Compasses, prismatic..........do	......	15
Equatorial telescope...........do	1	.....	Compasses, box..................do	1	9
			Compasses, pocket, square ....do	......	6
METEOROLOGICAL.			Compasses, round ....do	......	1
			Pocket sextants..................do	1	2
Barometer, aneroid ....number..	3	4	Watches ....do	31	3
Psychrometers ....do	......	2			
Thermometers..................do	......	3	DRAWING.		
GEODETIC.			Protractors, wooden, &c.....number..	......	5
			Protractors, Abbot's ....do	......	6
Compasses, surveyors'......number..	......	1	Drawing instruments.........boxes..	......	1
Theodolites, 9-inch............do	......	1	Triangles, metallic ....number..	......	2
Theodolites, 8-inch ....do	......	2	Rulers...........................do	......	2
Theodolites, 6-inch ....do	......	1			
Theodolites, 3-inch ....do	1	1	MISCELLANEOUS.		
Transits, railroad ....do	2	2			
Plane tables.....................do	1	4	Chronographs ....number..	2	.....
Standard bars ....do	......	1	Chronograph scales, glass .....do	2	.....
Chains, 100-foot..................do	......	5	Lee's Tables and Formulæ....do.....	......	1
Chains, 50-foot...................do	......	1	Instructions in photography, Abny, number..............................	......	10
Chains, 30 foot ....do	......	2			
Pins.................................sets...	4	9			
Tape, linen, 50 feet ....number..	......	1		54	133
Current meters..................do	......	7			
Self-registering tide-gauge paper, rolls.	......	2			

RIVERS AND HARBORS, Etc.

APPENDIX A.

IMPROVEMENT OF RIVERS AND HARBORS IN THE STATES OF MAINE, NEW HAMPSHIRE, AND MASSACHUSETTS.

REPORT OF COLONEL GEORGE THOM, CORPS OF ENGINEERS, BVT. BRIG. GEN., U. S. A., OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1881, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., July 16, 1881.

GENERAL: I have the honor to transmit herewith my annual reports of operations for the fiscal year ending June 30, 1881, on the several river and harbor improvements, as well as the examinations and surveys of rivers and harbors under my charge in the States of Maine, New Hampshire and Massachusetts.

Very respectfully, your obedient servant,

GEO. THOM,
Colonel of Engineers,
Bvt. Brig. Gen., U. S. A.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

A I.

BREAKWATER ON SAINT CROIX RIVER, NEAR CALAIS, MAINE.

This breakwater is situated on "The Ledge," about 5 miles below the bridge at Calais, Me. It consists of three crib-work piers, ballasted with stone, and was built by the United States Government in 1856 for the purpose of preventing vessels, in descending the river on the ebb-tide, from being thrown upon the ledge by the strong tidal current which sets directly upon it.

Hitherto this breakwater has answered its purpose in a very satisfactory manner; but it has become so much dilapidated as to necessitate its being at once *rebuilt.*

By the river and harbor act of March 3, 1881, the sum of $4,000 was appropriated by Congress for this purpose, and proposals have twice been invited for the work, resulting in an aggregate of only two bids, and in a contract made June 29, 1881, with Alfred Towers, of Calais, Me., for rebuilding the work complete for the sum of $3,700; the work to be commenced on or before the 11th of July, and completed on or before the 31st of October, 1881.

This breakwater is situated in the collection district of Passamaquoddy, of which Calais is the port of entry, the nearest light-house being at Dochet's Island, about 3 miles below it, on Saint Croix River; and the nearest fort is Fort Sullivan, at Eastport, Me., about 25 miles below.

The following information in regard to the revenue and commerce of this port for the year ending December 31, 1880, has been furnished by the United States deputy collector of customs, to wit:

Amount of revenue collected	$19,014 55
Value of imports	60,356 00
Value of exports	36,437 00
Number of vessels arrived	963
Number of vessels cleared	927

Vessels built, 1; tonnage, 32.94.

The following papers are hereto appended, viz:

Abstracts of proposals received.
Abstract of contracts made.

Money statement.

Amount appropriated by act approved March 3, 1881	$4,000 00
July 1, 1881, amount expended during fiscal year	24 59
July 1, 1881, amount available	3,975 41

Abstract of proposals received June 6, 1881, *for building breakwater near Calais, Me.*

Number for reference.	Bidders.	Residence.	Building crib-work breakwater.
1	Alfred Towers	Calais, Me	$4,218.60. By the job.

Abstract of proposals received June 25, 1881, *for building a crib-work breakwater in Saint Croix River near Calais, Me.*

Number for reference.	Bidders.	Residence.	Building crib-work breakwater.
1	Alfred Towers	Calais, Me	$3,700. By the job.

Abstract of contracts made during the fiscal year ending June 30, 1881, *for repairing breakwater on the Saint Croix River near Calais, Me.*

Number of contract.	Contractors.	Nature of work.	Price.
1	Alfred Towers, Calais, Me	Building crib-work breakwater, complete	$3,700

A 2.

IMPROVEMENT OF LUBEC CHANNEL, MAINE.

The following appropriations have been made by Congress for the improvement of Lubec Channel, Maine, viz:

By the river and harbor act of March 3, 1879	$44,000
By the river and harbor act of June 14, 1880	20,000
By the river and harbor act of March 3, 1881	45,000
Total	109,000

This channel is now obstructed by several shoals lying between the head of "the Narrows" and deep water below "Western Bar Beacon," a distance of about 2½ miles, on the shoalest parts of which there is not more than 5 feet of water at mean low-water, or about 2 feet at low-water of spring-tides. The mean rise and fall of the tides is 17 feet. The project that has been adopted for the improvement of this channel consists in widening and deepening the several shoals, by dredging to a depth of 12 feet at mean low-water (giving about 9 feet at low-water of spring-tides) for a width of not less than 200 feet, the estimated cost of which, as amended, is as follows, to wit:

1. For 16,770 cubic yards of dredging, measured *in situ* in "the narrows," at the places marked A and B on the map (that at C having been completed by the Atlantic Dredging Company, under its contract of September 23, 1879), at $1 per cubic yard, measured *in situ*	$16,770 00
2. For 200,000 cubic yards of dredging at the shoals between D and E on the map, at 50 cents per cubic yard, measured in scows	100,000 00
3. Engineering, superintendence, and other contingencies, say	17,230 00
Total	134,000 00

Under the appropriation of March 3, 1879, a contract was made September 23, 1879, with the Atlantic Dredging Company, of Hempstead, N. Y., for 136,320 cubic yards of the projected dredging; but the contracting party abandoned the work after having performed 3,720 cubic yards of dredging as stated in the last annual report.

Proposals were subsequently invited for this work three times (to-wit, April 19, May 27, and July 27, 1880), and on the 2d of September, 1880, a contract was made for the same with Messrs. Moore & Wright, of Portland, Me., under the appropriations of March 3, 1879, and June 14, 1880, combined, at prices as follows:

1. For 10,000 cubic yards, more or less, of dredging, measured *in situ*, at shoal A, at the head of "the Narrows," at $1 per cubic yard.
2. For 600 cubic yards, more or less, of dredging, measured *in situ*, at shoal B, at $1 per cubic yard.
3. For 90,000 cubic yards, more or less, of dredging, measured *in scows*, at the shoals between D and E, at 50 cents per cubic yard.

Under this contract dredging was commenced on the 1st of June, 1881, and continued throughout the month.

Proposals will be again invited (as soon as deemed advisable) for continuing this work under the appropriation of March 3, 1881.

Lubec Channel is situated in the collection district of Passamaquoddy, and the nearest port of entry is at Eastport, Me., about 3 miles above, at which place Fort Sullivan is situated. The nearest light-house is on West Quoddy Head, about 4 miles below.

The accompanying letter from the United States collector of customs at Eastport, Me., gives a statement of the amount of revenue collected at that port during the year ending December 31, 1880, as well as the amount of commerce and navigation that would be benefited by the projected improvement of Lubec Channel.

The following-named papers are hereto appended, viz:

Abstract of proposals received August 17, 1880.
Abstract of contracts made September 2, 1880.

Money statement.

July 1, 1880, amount available	$60,872 65	
Amount appropriated by act approved March 3, 1881	45,000 00	
		$105,872 65
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	3,119 40	
July 1, 1881, outstanding liabilities	544 10	
		3,663 50
July 1, 1881, amount available		102,209 15
Amount (estimated) required for completion of existing project		25,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		25,000 00

Abstract of proposals received August 17, 1880, for dredging in Lubec Channel, Maine.

Number for reference.	Bidders.	Residence.	The Narrows, Shoal A, 10,000 cubic yards.	Spit off Charley's Point, Shoal B, 600 cubic yards.	Shoals D and E, 120,000 cubic yards.
1	Moore & Wright	Portland, Maine	$1, measured *in situ*.	$1, measured *in situ*.	$0 50, measured in scows.

Abstract of contract made during the fiscal year ending June 30, 1881, for dredging in Lubec Channel, Maine.

Date of contract.	Contractors.	Nature of work—dredging.	Price per cubic yard.
1880. Sept. 2	Edward Moore, of Portland, Me., and Augustus R. Wright, of Geneva, N. Y., partners doing business under the firm name of Moore & Wright.	The Narrows, Shoal A, 10,000 cubic yards, more or less. Spit off Charley's Point, Shoal B, 600 cubic yards, more or less. Shoals D and E, 90,000 cubic yards, more or less.	$1, measured *in situ*. $1, measured *in situ*. 50 cents, measured in scows.

COMMERCIAL STATISTICS.

CUSTOM-HOUSE, EASTPORT, ME.,
Collector's Office, June 20, 1881.

DEAR SIR: In reply to your letter of the 17th, I submit the following report:

Amount of duties collected year ending December 31, 1880	$109,071 08
Value of imports for same period	$833,179 00
Value of exports for same period	$364,520 00
Number of vessels arrived	720
Number of vessels cleared	678
Number of vessels built	1

Very respectfully,

N. B. NUTT,
Collector.

General GEORGE THOM.

A 3.

IMPROVEMENT OF MOOSE-A-BEC BAR, AT JONESPORT, MAINE.

Moose-a-bec Bar is in the eastern part of Moose-a-bec Reach, at Jonesport, Me., and is the only obstruction to the safe navigation of that reach in all stages of the tide. It has only 5½ feet of water over it at mean low-water, and 3¼ feet in low-water of spring-tides, which compels the coastwise steamers and other vessels of greater draught to take a very tortuous course to the southward among the ledges, as shown on the map accompanying the last annual report. Navigation is thereby rendered difficult, and dangerous, especially at night, and in dense fogs, common on this part of the coast.

By the river and harbor act of March 3, 1879, provision was made for the survey of this place, with a view to the improvement of its navigation.

This survey was made in September and November, 1879, and the 3d of December, 1879, a report and map of the same were submitted to the department with a project and estimate for its improvement.

By this survey it was ascertained that a direct channel running nearly east and west in the direction of the tidal currents, could be opened without difficulty through the bar inside of Novas Rock, at a cost very small compared with the great benefit that would result to the commerce and navigation of this coast.

The area shaded in red on the map showed the location of this channel, which is projected to have a depth of 14 feet at mean low-water, or 11¾ feet in low-water of spring-tides, for a width of not less than 200 feet, and an average length of about 1,900 feet.

The mean rise and fall of the tides at this place (as determined by observations made day and night throughout a period of one lunation) is 11.53 feet. A channel of this depth would, in my opinion, answer the present wants of the ocean steamers and other vessels that pass coastwise through this reach, as well as those that would enter it as a harbor of refuge. Near the western end of this projected channel there is a sunken ledge which crops out to the southwest of "Steamboat buoy," with a least depth of 10¾ feet at mean low-water, but with 18 feet all around it. This ledge is also a dangerous obstruction to vessels when forced to make the abrupt change of course at this place in taking the channel south of Novas Rock, as well as to sailing-vessels beating up through the projected channel north of Novas Rock.

The removal of this ledge is also recommended to a depth of 15 feet, at mean low-water.

The estimated cost of this improvement is as follows, viz:

1. 64,164 cubic yards of dredging (*in situ*) at 40 cents per cubic yard	$25,665 60
2. Removal of 136½ cubic yards of sunken ledge (*in situ*) at $40 per cubic yard	5,460 00
Adding for engineering expenses, superintendence, and other contingencies	3,874 40
Total	35,000 00

By the river and harbor act of March 3, 1881, the sum of $10,000 was appropriated for this work.

Owing to the great scarcity, at the present time, of dredging machines that are suitable for doing this work, and the distance at which it is situated, it is believed that it cannot be advantageously undertaken at this time.

Proposals, however, will be invited therefor, at an early day, with a view to its partial completion this season if practicable.

Jonesport, Me., is an outport in the collection district of Machias, Me., and the nearest light-house is Moose-a-bec light.

The accompanying paper from the United States collector of customs furnishes a statement of the amount of commerce and navigation that would be benefited by the projected improvement of the channel at this place.

Money statement.

Amount appropriated by act approved March 3, 1881	$10,000 00
July 1, 1881, amount expended during fiscal year	8 75
July 1, 1881, amount available	9,991 25
Amount (estimated) required for completion of existing project	25,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	25,000 00

COMMERCIAL STATISTICS.

CUSTOM HOUSE, MACHIAS, ME.,
Collector's Office, June 23, 1881.

SIR: In reply to your letter of the 17th instant, I have the honor to report the following facts from the records of this office, viz:

1. The amount of revenue collected at Jonesport, during the year ending December 31, 1880, was	$783 00
2. Exports from the district for the same period	$71,890 00
Imports into the district for the same period	$1,783 00
3. Arrivals of vessels, foreign and domestic	73
Departure of vessels, foreign and domestic	232

4. See letter of Deputy Collector Johnson, inclosed.

Very respectfully,

GEORGE LEAVITT,
Collector.

General GEORGE THOM,
Colonel of Engineers, U. S. A.

LETTER OF DEPUTY COLLECTOR OF CUSTOMS AT MACHIAS, ME.

CUSTOM HOUSE, MACHIAS, ME.,
Deputy Collector's Office, Jonesport, June 22, 1881.

SIR: Yours of the 19th instant is received, and I will comply with your request as far as possible, but cannot be very definite on part of the questions submitted. In answer to question—

No. 1. There was received at this office, during the year ending 1880, including hospital money, $782.75.

No. 2. I will omit, as you are in possession of all the facts concerning the same.

No. 3. I cannot state the number of arrivals and departures from this port, as I have not kept a record of them, but will state that there were 178 business transactions during said year. There were 67 clearances, foreign, 2 foreign entrances, 3 coastwise clearances, and 17 coastwise entrances of vessels, sailing under register, and a large number of vessels engaged in the coastwise trade.

There are many arrivals and departures at and from this port, which are bound east and west, which come into this port for a harbor, it being very convenient to do so, by those who are well acquainted, and many take their chance of getting in safely, and many more would avail themselves of coming in, if not for the obstruction in entering (meaning the "Bar," it being most prominent).

No. 4. The amount of benefit which would result from the proposed improvement of the Moose-a-bec Bar is difficult to estimate. It is estimated that at least 1,500 vessels pass through this "Reach" annually, and that a large proportion of them are obliged to wait for the flow of the tide before they can enter or leave port, causing detention; and many who would avail themselves of this port for a harbor are obliged to seek some other place of refuge; also that steamers plying through this "Reach" are often obliged to wait over night on account of said obstruction (the bar), which, if removed, could proceed to their place of destination without any delay.

If the amount is estimated in money it is thought it would amount to $50,000 annually. Whether the amount is too high or low, I cannot say.

The foregoing report, although it may be very imperfect, is the best I can make.

Yours, respectfully,

J. M. JOHNSON,
Deputy Collector.

COLLECTOR OF CUSTOMS,
Machias, Me.

A 4.

IMPROVEMENT OF BELFAST HARBOR, MAINE.

By a survey of this harbor made in 1875 it was found that in front of the wharves on its west side it was obstructed by a shoal extending from near Leane's wharf, where there was a least depth of 4 feet at mean low-water, downwards with increasing depths to 12 feet of water, about midway between Sanford's Boston steamer wharf and McGilvery's shipyard.

To meet the wants of the commerce of this harbor, and to enable the coastwise steamers and other vessels frequenting it to enter and leave at all stages of the tide, a project was adopted for removing this shoal to a depth of 10 to 12 feet at mean low-water at an estimated cost of $25,000.

For this improvement the following appropriations have been made by Congress, to-wit:

By act approved August 14, 1876	$5,000
By act approved June 18, 1878	12,000
By act approved March 3, 1879	5,000
By act approved June 14, 1880	3,000
Total	25,000

Under these appropriations all the projected work has been completed, leaving a surplus of $3,000.

In order to make this improvement permanent it may be found necessary to build a stone jetty out from the north shore of the harbor (as shown on the map accompanying the last annual report), so as to divert the direction and force of the ebb-tidal currents upon the dredged area, and by the scouring effects prevent a reformation of the shoal.

The estimated cost of a rubble-stone jetty is	$18,000
Amount appropriated by the act of June 14, 1880, for improving this harbor is	3,000
Additional amount required for completing the jetty would be	15,000

Should this project be adopted, it is proposed to defer applying the funds now available to a commencement of the jetty, as the benefit resulting therefrom would be too small to warrant its expenditure until another appropriation be made with a view to its completion, which at present is not recommended.

Belfast Harbor is the only port of entry in the district of Belfast, Me. The nearest light-houses are those on Dice's Head, near Castine, and on Fort Point; both about 10 miles from Belfast, and the nearest fort is Fort Knox, opposite Bucksport, about 18 miles from Belfast.

The following information in regard to the revenue and commerce of the district of Belfast, for the year ending December 31, 1880, has been furnished by the United States collector of customs at that port, viz:

Amount of revenue collected	$1,576 89
Amount of exports	3,436 82
Amount of imports	4,605 36

Arrivals and departures of vessels, for the greater part of the year, daily, 8 to 10 vessels built, 7, of an aggregate tonnage of 2,058.38.

Money statement.

July 1, 1880, amount available	$3,000 00
July 1, 1881, amount available	3,000 00

A 5.

IMPROVEMENT OF ROCKLAND HARBOR, MAINE.

By the river and harbor act of June 14, 1880, the sum of $20,000 was appropriated for the improvement of this harbor.

The project that has been adopted for this improvement consists in the construction of two breakwaters to a height of 5 feet above mean low-water, with a width on top of 10 feet, one commencing at Jameson Point and extending in a direction about S. 16½° E. for a distance of 1,900 feet, and the other commencing at South Ledge and extending in a direction about N. 9° E. towards Jameson Point, for a distance of 2,640 feet, as shown in the accompanying sketch.

The estimated cost of these breakwaters (as revised) is as follows, to wit:

1. For breakwater DE at Jameson Point, 135,000 tons of rubble stone, at 80 cents per ton	$108,000
2. For breakwater AC (extending from South Ledge towards Jameson Point), 420,000 tons of rubble stone, at 80 cents per ton	336,000
Adding for engineering expenses and other incidental expenses, say	56,000
Total	500,000

A project submitted by me on the 15th of December, 1880, having received the approval of the Department, it has been decided in compliance therewith to apply the $20,000 appropriated by the river and harbor act of June 14, 1880, to the partial construction of the Jameson Point Breakwater, by building it with a width of 10 feet on top, to a height of about 5 feet above mean low-water, for a length of about 960 feet, leaving its completion, and that of the breakwater AC, to be dependent upon such appropriations as may hereafter be made therefor by Congress.

In carrying out the adopted project proposals were twice invited for about 30,000 tons of rubble stone for this work (see abstract of same herewith), and on the 8th of March, 1881, a contract was made with the Bodwell Granite Company, of Rockland, Me., the lowest of nine bidders, for 24,000 tons of rubble stone, at 74½ cents per ton of 2,240 pounds, placed in the work.

The delivery of the stone was commenced in the latter part of April, and continued up to the close of the fiscal year, during which 13,006 tons have been furnished and placed in the work, whereby the work has been completed for a length of about 560 feet.

This contract is to be completed on or before the 30th of November, 1881.

Rockland is a port of entry in the collection district of Waldoborough, Me., and the nearest light-house is at Owl's Head, distant about 2 miles.

The accompanying letter from the United States deputy collector of customs furnishes a statement showing the extent to which the commerce of this harbor and coast would be benefited by the projected breakwater in affording shelter for the shipping in the violent and dangerous easterly storms to which it is now so much exposed.

OF

BOR MAINE·

THE PROPOSED BREAKWATERS

PECIAL SURVEY

e direction of

COLONEL OF ENGINEERS.

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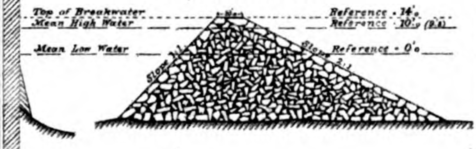
and are referred to the

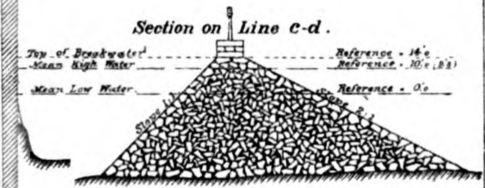
9.8 Ft.

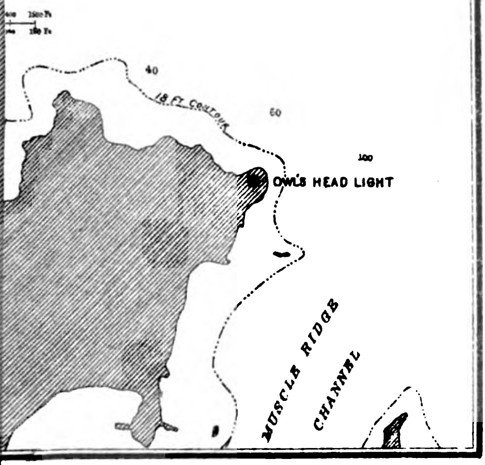
n low water 12.8 Ft.

Section on Line a-b.



Section on Line c-d.





The following-named papers are hereto appended, viz:

Two abstracts of proposals.

One abstract of contracts.

Sketch of Rockland Harbor, Maine, showing the sites and plans of the proposed breakwater, as determined by a special survey made in 1880.

Money statement.

July 1, 1880, amount available		$20,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$9,854 99	
July 1, 1881, outstanding liabilities	968 93	
		10,823 92
July 1, 1881, amount available		9,176 08
Amount (estimated) required for completion of existing project		480,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		105,000 00

Abstract of proposals received January 31, 1881, *for furnishing* 30,000 *tons, more or less, of rubble stone for projected breakwater at Jameson Point, Rockland Harbor, Maine.*

Number for reference.	Bidders.	Residence.	Granite grout.	Remarks.
1	John F. Hamilton	Portland, Me	79½ cts. per ton of 2,240 lbs.	For 30,000 tons, more or less, granite quarry grout.
2	Hugh Bowen and Joseph F. Curit.	Chebeaque Island, Me.	81½ cts. per ton of 2,240 lbs.	
3	John S. Hopkins	Vinal Haven, Me	98 cts. per ton of 2,240 lbs.	
4	Mount Waldo Granite Works.	Frankfort, Me	$1.35 per ton of 2,240 lbs.	
5	Isaac A. Sylvester	Boston, Mass	$1.47 per ton of 2,240 lbs.	

Abstract of proposals received March 1, 1881, *for furnishing* 30,000 *tons, more or less, of rubble stone for projected breakwater at Jameson Point, Rockland Harbor, Maine.*

Number for reference.	Bidders.	Residence.	Granite grout.	Remarks.
1	Bodwell Granite Company.	Rockland, Me	74½ cts. per ton of 2,240 lbs.	For 30,000 t more or less, ite quarry g
2	Hugh Bowen, Joseph F. Curit, and John F. Hamilton.	Chebeaque Island, Me. Portland, Me	77½ cts. per ton of 2,240 lbs.	
3	John S. Hopkins	Vinal Haven, Me	87 cts. per ton of 2,240 lbs.	
4	Davis Tillson	Rockland, Me	90 cts. per ton of 2,240 lbs.	

Abstract of contracts made during the fiscal year ending June 30, 1881, *for the impr of Rockland Harbor, Maine.*

Date of contract.	Contractor.	Nature of work.	
1881. March 8.	Bodwell Granite Company, of Rockland, Me.	For furnishing and placing 24,000 tons, more or less, of granite quarry grout on projected breakwater at Jameson Point.	74½

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or contingencies,
46,000
470,000

COMMERCIAL STATISTICS.

CUSTOM HOUSE, *Rockland, Maine, June 27*, 1881.

DEAR SIR: Your favor of the 17th instant received, but owing to a pressure of official business, I have not been able to give it my attention until now.

The following is from our records:

Revenue collected: Duties, $791.99; tonnage tax $751.50	$1,543 49
Arrivals from foreign ports (entries)	117
Clearances for foreign ports	134
Vessels built 2; tonnage	133
Vessels under construction, and contracted for this year 6; with an aggregate tonnage of above 1,500 tons.	

To question 4 I can only refer you to my former letters, of last year.

* * * * * * *

We have some 200 vessels aggregating about 30,000 tons, and we employ a large number besides.

We have 6 steamers of our own, plying to the different ports east daily, besides the daily line to Boston and the 2 steamers to Portland and weekly line to New York.

You can figure on nearly all of the commerce east of this port that will be benefited by the breakwater, as now on an easterly they never leave the island ports and thoroughfares, and winds shifting as they do in the fall and spring, to the northwest, they have to lie at these ports until it moderates, whereas, if they had the benefit of a shelter at Rockland, they would be on the weather shore, and ready to proceed immediately on the change.

I expect that, as soon as it is generally known that the piece (of the breakwater) that is already built affords some shelter, our harbor will be filled with vessels, in fact I understand from our boarding officer that they are even now seeking its lee.

* * * * * * *

Very respectfully

J. W. CROCKER,
Deputy Collector of Customs.

General GEORGE THOM,
Colonel of Engineers, U. S. A.

PROJECT OF COLONEL GEORGE THOM, CORPS OF ENGINEERS, FOR THE IMPROVEMENT OF ROCKLAND HARBOR, MAINE, SUBMITTED JULY 14, 1880.

By the river and harbor act of June 14, 1880, the sum of $20,000 was appropriated for the improvement of this harbor. Not having received from the department the information asked for in my letter of the 23d ultimo, as to the object of this appropriation, I wrote to Hon. Thomp-
n H. Murch, the Representative in Congress of the district, for such
ormation as he could furnish in regard to it. In response he sent
me a printed map without date, showing the location and plan of a
eakwater in Thomaston Harbor, Maine. In 1848, the name of this
bor was changed to Rockland Harbor, and the drawing of "Thomas
Harbor" referred to can probably be found in the department.

he inclosed Coast Survey map of Rockland Harbor shows the loca-
of the breakwater as hitherto projected at A, drawn in black. But
ould, if so located, protect only a small portion of the harbor which
ater depth than 9 feet at mean low-water, I have shown on the
ation of a work which is much better suited to the wants of
ut it would be a much more expensive work than that first

the one first proposed provided for a length of 2,500
24 feet on top, with an inner slope of 45°, and an
the stone to be carefully placed so as to present an
location the average depth of water is about 16

In the location where I have placed it on the map, it has a length of 4,000 feet in an average depth of about 25 feet of water at mean low-water.

Assuming for these breakwaters the smallest dimensions of cross-section which in my opinion would be admissible, viz: a height of 15 feet above the plane of mean low-water (or 3½ feet above the highest spring tides), a width of 20 feet on top, an inner slope of 45°, and an exterior slope of 1: 2, their probable cost for rubble stone loosely thrown or dumped upon the works would be as follows:

1. The inner breakwater 2,500 feet in length, say 170,000 tons of rubble stone at 80 cents per gross ton	$136,000
Adding for contingencies say	14,000
Total	150,000
2. For the outer breakwater, B, 4,000 feet in length, 800,000 tons of rubble stone at 80 cents	640,000
Adding for engineering expenses, superintendence, and other contingencies, say	60,000
Total	700,000

Whilst the great cost of this (outer) breakwater would probably preclude its being built, the inner one at A, would not in my opinion be of sufficient benefit to the harbor to warrant its adoption.

I will here add that Mr. Murch has suggested a location and length for the work very nearly the same as the outer one at B.

Respectfully submitted.

GEO. THOM,
Colonel of Engineers,
Bvt. Brig. Gen., U. S. A.

SUPPLEMENTARY PROJECT.

UNITED STATES ENGINEER OFFICE,
Portland Me., July 21, 1880.

GENERAL: On the 14th instant, I had the honor to submit to the department a "project for the improvement of Rockland Harbor, Maine," under the appropriation of $20,000 made by the river and harbor act June 14, 1880.

That project was based on a Coast Survey chart of the harbor then in my possession. I have since obtained a recent issue of that chart, dated 1876, which furnishes more important data upon which to determine the location, extent and cost of the proposed work. Jameson's Point Ledge, South Ledge, and the shoal to the southward of South Ledge, would appear to be good guides for the location of the work. Here the average depth of water at mean low-water is about 20 feet, for an extent of about 3,500 feet; so that a rubble stone breakwater for this length and depth, with the minimum height and cross-section before assumed, would require:

About 530,000 gross tons of stone, the cost of which at 80 cents per ton would be	$424,000
Adding for engineering expenses, superintendence, and other contingencies, say	46,000
Total	470,000

Should it be deemed necessary to cap the work and place the stone so as to have an even surface, the cost would be materially increased.

Very respectfully, your obedient servant,

GEO. THOM,
Colonel of Engineers,
Bvt. Brig. Gen., U. S. A.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS, U. S. ARMY,
July 24, 1880.

Respectfully referred to Col. Z. B. Tower, Corps of Engineers, for consideration of the Board of Engineers for Fortifications and River and Harbor Improvements, in connection with other papers on same subject sent with department letter of July 19.

By command of Brigadier-General Wright:

H. M. ADAMS,
Captain of Engineers.

REPORT OF THE BOARD OF ENGINEERS.

OFFICE OF BOARD OF ENGINEERS FOR FORTIFICATIONS
AND FOR RIVER AND HARBOR IMPROVEMENTS, &C.,
New York, September 10, 1880.

GENERAL: The Board of Engineers for Fortifications and River and Harbor Improvements, to whom was submitted the project of General Geo. Thom, the local engineer, for the application of the appropriation of $20,000 under the last river and harbor act for improving Rockland Harbor, Maine, have the honor to report.

By letter from the office of the Chief of Engineers of July 19 last, the Board are directed to give the subject such examination as would enable them to report their views in regard to the proper plan of improvement, with an estimate of cost.

The harbor of Rockland, an indentation of the coast at the southwest extremity of Penobscot Bay, formed by the projecting headlands of Owl's Head and Jameson's Point, is exposed to the direct action of the winds from north 22° east to south 60° east. From north 22° east to north 70° east, the winds generally have the whole sweep of the bay with a rake of 23 miles about, throwing in a heavy sea. From north 70° east to south 60° east, the Fox Islands intercept the great ocean waves. The rake of the winds between these limits from the islands into the harbor varies 8 and 16 miles, and the heights of the waves are diminished in consequence. When the wind is east-southeast, or about that point, it is said that a heavy ground swell is thrown into the harbor more destructive than any other to which the bottom is exposed, though it passes into the harbor in an indirect manner between the Fox Islands and Owl's Head. These storms are fortunately neither frequent nor long in their duration, so that winds from the north of east may be said to be, on the whole, the most hurtful to which this place is exposed.

The harbor has a wide entrance and good anchorage, is deep and spacious, and with competent protection would prove valuable as a harbor of refuge. From the returns made by the light-keeper at Owl's Head, it appears that between sunrise and sunset, from January 1, to December 31, 1879, the number of vessels passing his station amounted to 21,539, including barks, brigs, schooners, sloops, and steamers. This enumeration excludes vessels passing outside through the Fox Island channel. If to the above be added those passing after sunset, the number might be estimated at nearly 30,000.

No convenient harbor of refuge exists for a long stretch of coast, the contiguous harbor at Owl's Head being exposed to winds from north 28° east to east.

The harbor was visited by a member of the Board, and the local engineer appeared before the Board to furnish information and present his views.

The improvement contemplated under the appropriation, and desired by the residents, is a breakwater, and the Board adopt the line recommended by the local engineer, and the cross-section, modified only by making it 10, instead of 20, feet wide on the top.

The breakwater thus placed, and extending through a length of 3,400 feet, will provide an excellent harbor of refuge, and will incidentally cover the largest portion of the wharves of the town. Those about Atlantic Point will not be so well covered as others to the northward. Should it be desirable to protect this portion, it would be far preferable (as to cost) to provide a special structure there, which might be placed close in shore at small outlay, rather than fulfill the same object by extending considerably the proposed breakwater southward into water 6½ to 8 fathoms in depth at low-water.

The ground swell, which is said to come from heavy east-southeast winds, would affect the north part only of the harbor, and the Board do not think it necessary, on this account, to project a work with dimensions of cross-section greater than that for similar works executed in Long Island Sound under circumstances of apparently the same exposure.

ESTIMATE FOR A BREAKWATER 3,400 FEET LONG, 4 FEET ABOVE MEAN HIGH-WATER, WITH AN EXTERIOR SLOPE OF ½ AND INTERIOR SLOPE OF 1/1.

419,362 tons of stone, at 60 cents	$251,617 20
Contingencies, 10 per cent	25,161 72
Total	276,778 92

The Board are led to adopt this estimate per ton from information conveyed to them of the convenience and cheapness of furnishing stone at this locality, and the Board have been assured by prominent citizens and proprietors of quarries that stone could be furnished at 60 to 75 cents per cubic yard, delivered in the breakwater.

The Board would likewise suggest that, as an experiment, the two extremities only of the breakwater be built to the height proposed, while the intermediate portion be carried to a height of 5 feet above mean low-water. Experience would soon decide whether such diminished height could give competent protection to vessels and sufficient strength to the structure itself.

In establishing the small cross-section which is adopted at other parts of the coast, and in suggesting a diminution of height in a portion of the breakwater, the Board are actuated by the desire to have the work executed at the minimum cost. Direct experience as to the effect of exposure to waves is wanting for this place, and any deficiency in strength or other particular could be rectified as the work progresses.

The cost of breakwater, modified as above in respect to height, would be $213,600.42.

Respectfully submitted.

Z. B. TOWER,
Colonel of Engineers, Bvt. Maj. Gen.
JOHN NEWTON,
Colonel of Engineers, Bvt. Maj. Gen.

The CHIEF OF ENGINEERS, U. S. A.

LETTERS OF CAPTAIN CHARLES DEERING.

1.

PORTLAND, *October* 25, 1880.

DEAR SIR: I write to your honorable Board of Engineers in regard to the building of a breakwater at Rockland, Me.

I have been master of a steamer running to that port for a long time; have talked with all of our masters of steamers in regard to the breakwater, besides many prominent men and masters of vessels. In their behalf I would most respectfully ask that the breakwater be built so as to make the harbor as large as possible.

This plan I suggest to your honorable Board gives us a very much larger harbor, and will protect the wharves as well as give us a very much larger anchorage for a larger class of vessels, which is very much needed; also give our steamers very much better chance to get in and out of the harbor, besides protect the harbor from being filled up with ice coming down the bay. This plan I think would protect Atlantic Wharf well enough; General Tilson's wharf would be entirely protected.

I inclose a plan suggested by myself and approved by our masters. Of course it will cost more than the other, but see what a spacious harbor it gives us in return. This place does increase very fast, and it has become a necessity in fact to have a breakwater; for in heavy northeast and east-northeast storms we cannot land at all—have to go by and find a harbor until the storm is over. I have done so many times at great inconvenience to my passengers.

This breakwater will be a great help to the city of Rockland in many ways; also to our lines of steamers, and to the coasting trade generally. You could build off Jameson's Point first, which would help us very much, for we now anchor off that point in a northeast snow storm often, and this breakwater off the point would help us at once—every rod would count, you will see by my plan.

I hope your honorable body will adopt this plan.

Very respectfully, yours, &c.,

CHARLES DEERING,
Master Steamer Lewiston.

General H. G. WRIGHT,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS, U. S. ARMY,
November 2, 1880.

Respectfully referred to Col. Z. B. Tower, Corps of Engineers, for consideration and report of the Board of Engineers for Fortifications and for River and Harbor Improvements, in connection with previous papers herewith.

By command of Brigadier-General Wright:

JOHN G. PARKE,
Lieutenant-Colonel of Engineers,
Bvt. Maj.-Gen., U. S. A.

[Second indorsement.]

OFFICE BOARD OF ENGINEERS,
New York, November 16, 1880.

Respectfully returned to the Chief of Engineers with inclosures.

The project of the breakwater submitted by the Board was intended to afford adequate protection to that portion of the coasting traders which might seek refuge in Rockland Harbor, and is considered sufficient for that purpose. Vessels of greater size, especially those employed in European commerce, would not require nor seek the protection afforded by this breakwater. A breakwater, or system of breakwaters, the Board were well aware might have been projected far superior in the extent of anchorage covered, but the question of cost also was, as it should have been, an essential element in determining a project suited to the place. The project of Captain Deering will cost, in round numbers, $500,000; that of the Board, $300,000. If the difference in cost be considered immaterial, the former should undoubtedly be adopted. Notwithstanding, it is believed that the latter will subserve the essential wants of commerce as well as be capable of any desired extension in the future.

Respectfully submitted.

In behalf of the Board.

Z. B. TOWER,
Colonel of Engineers and Bvt. Maj.-Gen.,
Senior Member on duty.

2.

PORTLAND, *December* 6, 1880.

SIR: Yours of November 18 was duly received and contents noted.

It is very evident to me that the amount of shipping to Rockland coastwise, foreign, and engaged in the fisheries, besides the amount of steam-vessels touching there, *has not been fully represented to you.*

Nine months in the year, for the last fifteen years, I have made a landing at Rockland with my steamer (which is about 1,200 tons), four times a week, for most of the time; therefore you must allow me to know the wants, &c., at that point. Many is the time that a harbor, built as you propose, would not hold the amount of shipping anchored there, leaving the larger class outside, and in heavy weather there would not be any show, either to get in or out of the harbor with our steamers.

I had much rather the harbor should remain as it is than build as you propose, and that is the opinion of the masters; we all have had the matter under consideration.

You speak of the matter of cost; in my judgment, cost is not to be taken into consideration, provided it comes within bounds of reason. In this case $500,000 is not a large sum for the amount of benefit we should derive from it. Build off Jameson's Point first; that done, then the other.

There has been property enough lost already in this harbor to build most of it.

We run our steamers the year round; in stormy weather we are put to a great inconvenience and great risk of lives and property; it has gone on long enough, now let us have what we want; we help pay for it and we want an equivalent. We run a daily line of steamers from Portland part of the year, touching at Rockland each way; balance of the year, two trips a week, touching at Rockland four times a week. From Boston there is a daily line of steamers, larger than ours, which touch there each way part of the season; balance of the year, three times a week; besides a daily line from Rockland east, and lots of smaller steamers.

This business employs six good size side-wheel steamers, valued at $1,000,000, employing over 400 people, besides the small steamers.

There is a race of people to come after us, and their convenience is to be consulted or looked out for. As for money, we can raise the $500,000 sure; it will be forthcoming; there is no such word as fail.

Very respectfully, your obedient servant,

CHARLES DEERING.

The CHIEF OF ENGINEERS, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS, U. S. ARMY,
December 9, 1880.

Respectfully referred to Col. George Thom, Corps of Engineers, for consideration and report.

Colonel Thom will suspend advertisement for proposals, if not already published.

By command of Brigadier-General Wright:

JOHN G. PARKE,
Lieutenant-Colonel of Engineers,
Bvt. Maj.-Gen., U. S. A.

[Second indorsement.]

UNITED STATES ENGINEER OFFICE,
Portland, Me., December 15, 1880.

Respectfully returned to the Chief of Engineers, accompanied by a special report.

GEO. THOM,
Colonel of Engineers,
Bvt. Brig. Gen. U. S. A.

REPORT OF COL. GEORGE THOM, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., December 15, 1880.

GENERAL: I have the honor to acknowledge the receipt from the department, for my consideration and report, a letter to the department from Mr. Charles Deering, dated at Portland, Me., December 6, 1880, urging a reconsideration of his project for the improvement of Rockland Harbor, Maine.

Mr. Deering's project consists of—

First. A breakwater, extending from the "South Ledge" northward, towards Jameson's Point, for a length of one-half a mile, as shown on the accompanying drawings by the line and plan marked A C; also

Second. A jetty built out from Jameson's Point, as shown on the drawings by the line D E, for a distance of about three-eighths of a mile.

The project submitted by myself July 21, 1880, consisted of a breakwater, about 3,400 feet in length, extending from "South Ledge" to "Jameson's Point Ledge," covering the intermediate ledges, as shown the accompanying drawings, by the plan and line A B. This location was recommended by me as being the least expensive for a breakwater, with the belief, after consultation with parties instrumental in the inception of the work, that it would fully answer the purposes intended.

My project was referred by the department to the Board of Engineers for Fortifications and for River and Harbor Improvements, &c. Subsequently, one of the members of that Board and myself visited Rockland Harbor, and, after consultation with several of the most prominent persons who were interested in the matter, we came to the conclusion that the location of the breakwater proposed by me would fully meet the wants of that harbor; and in further consideration of its being the least expensive of several plans suggested, it was finally adopted and recommended by the Board, in its report of September 10, 1880, a copy of which I received on the 20th of October, 1880.

A few days previous to my receiving the report of the Board, Mr. Charles Deering and Hon. T. H. Murch called at my office and presented for my consideration a project for the improvement of Rockland Harbor by means of a breakwater, A C, and jetty, D E, as above described, which impressed me so favorably that I suggested that they should submit it to the department, believing then, as I do now, that it would make a more capacious and better-protected harbor than the one first proposed by myself; but supposing that its much greater cost would probably prevent its adoption under the small appropriation of $20,000 that had been made for this harbor; for which reason other similar plans suggested were not at first recommended for adoption.

For a more thorough understanding of this matter, I have recently had made an accurate survey covering all the proposed locations of the breakwater and jetty, and new estimates (based on the results of the survey) made of those several works, adopting therein the height and dimensions recommended therefor in the report of the Board of Engineers.

The estimates are as follows, viz:

1. For the originally proposed breakwater A B, 3,400 feet long, 4 feet above mean high-water, with an exterior slope of $\frac{1}{3}$ and an interior slope $\frac{1}{1}$:	
485,000 tons of rubble-stone, at 60 cents	$291,000
Adding for contingencies	29,000
	320,000
2. For the project suggested by the Board, as an experiment, for reasons of economy, in which the two extremities only of the breakwater A B are to be built to the height above proposed, while the intermediate portion be carried to a height of only 5 feet above mean low-water:	
300,000 tons of rubble-stone, at 60 cents	180,000
Adding, for contingencies	20,000
	200,000
3. For the breakwater A C and jetty D E, proposed by Mr. Deering, both carried to a height of 4 feet above mean high-water, with exterior slopes of $\frac{1}{3}$ and interior slopes of $\frac{1}{1}$, and a width of 10 feet on top:	
(*a*) Breakwater, 2,640 feet long, 600,000 tons of rubble-stone, at 60 cents	360,000
(*b*) Jetty, 1,900 feet long, 220,000 tons of rubble-stone, at 60 cents	132,000
Adding, for contingencies	53,000
	545,000

4. For the breakwater A C and jetty D E, both carried at their extremities, only to a height of 4 feet above mean high-water, with the other portions to a height of only 5 feet above mean low-water, as an experiment:

(*c*) Breakwater, 420,000 tons of rubble-stone, at 60 cents	$252,000
(*d*) Jetty, 135,000 tons of rubble-stone, at 60 cents	81,000
Adding for contingencies	37,000
	370,000

The difference of results in the above estimates 1 and 2 from those submitted by the Board may be attributed to the more accurate and reliable data furnished by the recent survey of the locality, the estimates therefor by the Board being, respectively, $276,778.92 and $213,600.42.

Of all the projects proposed and estimated for, as above, the breakwater A C combined with the jetty D E, both carried to the full height throughout, is, in my opinion, the best for making a well-protected harbor with capacious and good anchorage, and for affording an easy ingress and egress on the north and south sides of the harbor, together with the largest protection to the wharves in the harbor. Even in its present condition, the shoal making out from Jameson's Point affords the best and safest shelter now to be had for vessels caught in this harbor in easterly storms; and by utilizing and extending this protection by means of the proposed jetty alone a good temporary shelter and anchorage would be obtained, though quite insufficient for the general wants of the commerce of this harbor.

As none of the projects herein proposed have been hitherto submitted, with estimates for their completion, for the consideration of Congress, it remains to be seen to what extent these projects will be likely to be adopted under future legislation.

Under these uncertainties, and in view of the possible ultimate adoption of the project for the breakwater A C combined with the jetty D E off Jameson's Point; also with a view to providing at the least expense, and at the earliest date practicable, a good shelter for vessels caught in this harbor by the most dangerous storms from the north of east; and after further consultation with parties whose knowledge of the harbor and its wants are entitled to great weight, I would now respectfully recommend that under the present appropriation of $20,000 the work at Jameson's Point should be taken in hand first; and that it be built, at present, to a height of only 5 feet above mean low-water, say for a distance of about 950 feet out from high-water mark; and, under future appropriations, that it be extended, with the same height, to the length projected, to wit, 1,900 feet, terminating in 26 feet of water at mean low-water, its outer end to be so built as to serve for a permanent beacon.

Should it be found advisable, at any future time, to raise the work to any greater height, or even to the full height of 4 feet above mean high-water, no difficulties will have been interposed by the work previously done; also, should appropriations hereafter be made to justify the commencement of the breakwater A C, it can be commenced and built from its northern extremity, and thereby, in conjunction with the work previously completed at Jameson's Point, afford an increased shelter and capacity for the harbor to such extent as the appropriations made therefor will allow it to be carried towards "South Ledge," its projected southern terminus.

Very respectfully, your obedient servant,

GEO. THOM,
Colonel of Engineers,
Bvt. Brig. Gen., U. S. A.

g. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 22, 1880.

SIR: On the 15th September last, I had the honor to submit the report of the Board of Engineers for Fortifications and for River and Harbor Improvements upon the project submitted to this office by Col. George Thom, Corps of Engineers, for improvement of Rockland Harbor, Maine, under an appropriation of $20,000 made therefor by the river and harbor act of June 14, 1880, which received your approval October 15, 1880. Subsequently, under date October 25, Capt. Charles Deering, of Rockland, submitted a plan for a breakwater at that place which, based upon his experience as a navigator and his knowledge of the needs of the harbor, he considered better adapted to the requirements of navigation than that proposed by the Board of Engineers, and which, though more costly, would afford much better protection as a harbor of refuge from the heavy storms prevalent on that coast. This project, striking me favorably, was sent also to the Board of Engineers for Fortifications and for River and Harbor Improvements for consideration and report in connection with the previous papers, and was returned to this office with remark that—

> The project of the breakwater submitted by the Board was intended to afford adequate protection to that portion of the coasting traders which might seek refuge in Rockland Harbor, and is considered sufficient for that purpose. Vessels of greater size, especially those employed in European commerce, would not require nor seek the protection afforded by this breakwater. A breakwater, or system of breakwaters, the Board were well aware, might have been projected far superior in the extent of anchorage covered, but the question of cost also was, as it should have been, an essential element in determining a project suited to the place. The project of Captain Deering will cost in round numbers $500,000; that of the Board, $300,000. If the difference in cost be considered immaterial, the former should undoubtedly be adopted. Notwithstanding, it is believed that the latter will subserve the essential wants of commerce as well as be capable of any desired extension in the future.

Captain Deering, who was vouched for by Hon. T. H. Murch, was duly notified of the views of the Board above given, and in reply thereto, under date December 6, in behalf of the masters of steamers visiting the harbor and for himself, expressed so strenuously the opposition entertained to the construction of the breakwater proposed by the Board, that I was induced to submit the question to Col. George Thom, the officer in charge, for consideration and report.

Colonel Thom, with the view to a more thorough understanding of the matter, has made an accurate survey covering all the proposed localities of the breakwaters and jetty upon which new estimates were based (adopting the height and dimensions recommended by the Board of Engineers) resulting as follows:

1. For originally proposed breakwater	$320,000
2. For the project recommended by the Board as an experiment, the two extremities of the breakwater only to be built to the height of 4 feet above mean high-water, the intermediate portion to be only 5 feet above mean low-water	200,000
3. For the breakwater proposed by Captain Deering, both carried to a height of 4 feet above mean high-water, &c	545,000
4. For the same, both carried at their extremities only to a height of 4 feet above mean high-water, with other portions to a height of only 5 feet above mean low-water	370,000

Colonel Thom remarks:

> Of all the projects proposed and estimated for as above, the breakwater A C combined with the jetty D E (Captain Deering's plan), both carried to the ful

height throughout, is, in my opinion, the best for making a well-protected harbor, with capacious and good anchorage, and for affording an easy ingress and egress in the north and south sides of the harbor, together with the largest protection to the wharves in the harbor. Even in its present condition the shoal making out from Jameson's Point affords the best and safest shelter now to be had for vessels caught in this harbor in easterly storms; and by utilizing and extending this protection by means of the proposed jetty alone a good temporary shelter and anchorage would be obtained, though quite insufficient for the general wants of the commerce of this harbor.

Colonel Thom "after further consultation with parties whose knowledge of the harbor and its wants are entitled to great weight," recommends that:

> Under the present appropriation of $20,000, the work at Jameson's Point should be taken in hand first, and that it be built at present to a height of only 5 feet above mean low-water, say for a distance of about 950 feet out from high-water mark, and under future appropriations that it be extended with the same height, to the length projected, to-wit, 1,900 feet, terminating in 26 feet of water at mean low-water, its outer end to be so built as to serve for a permanent beacon.

I concur in Colonel Thom's views and recommendations. The work can at any time be raised to a greater height if found necessary, and if hereafter the proposed breakwater A C be commenced it can be built from its northern end, thus constantly adding during its construction to the shelter and capacity of the harbor.

It is accordingly recommended that the plan as shown on the sketch accompanying Colonel Thom's letter of December 15, 1880 (herewith), combining the jetty D E and breakwater A C, be approved.

Previous papers herewith.

Very respectfully, your obedient servant,

H. G. WRIGHT,
Chief of Engineers,
Brig. and Brt. Maj. Gen.

Hon. ALEXANDER RAMSEY,
Secretary of War.

[First indorsement.]

The recommendation of the Chief of Engineers is approved.

By order of the Secretary of War.

H. T. CROSBY,
Chief Clerk.

WAR DEPARTMENT,
December 29, 1880.

A 6.

IMPROVEMENT OF RICHMOND HARBOR, KENNEBEC RIVER, MAINE.

By the river and harbor act of June 14, 1880, provision was made for a survey of this harbor, in Kennebec River, Maine, with a view to its improvement; this survey was made in November last, and on the 10th of December, 1880, a report on the same was submitted by me to the department with a project and estimate for its improvement.

Kennebec River is here divided by Swan Island into two channels, of which the main channel passes to the eastward of the island, through "the Narrows," with a navigable depth of 10 to 11 feet at mean low-water, whilst the western channel, which forms Richmond Harbor, so called, is navigable for the same depth, except at the following places, to-wit:

1. At the head of Swan Island.
2. At Hatch's Rocks Shoal, about 2 miles below head of island.
3. At the foot of Swan Island, about 5 miles below its head.

The shoal at the head of Swan Island was improved in 1872 by dredging to a depth of 10 feet at mean low-water (or 15 feet at ordinary high-water); but, as was then predicted, it has been reproduced by the same causes as before. For insuring the continuance of its depth, if again dredged, it is recommended that a wing-dam be built out from the upper end of Swan Island, as shown on the sketch accompanying report on the survey, in order to create a greater scour on *the bar*, by the diversion into its channel of a part of the water of the main channel.

For a similar purpose a wing-dam is also recommended to be built out from the western shore at Hatch's Rocks Shoal, as shown on the sketch; which, in connection with the projected dredging at that shoal, will, it is believed, insure the desired depth of 10 feet at mean low-water.

At the lower end of this harbor, near the foot of Swan Island, ice-houses have been built and projected to such an extent as to warrant an improvement of the channel at that place by widening and deepening the same where shaded in blue on the sketch. In this locality it is proposed to make the channel not less than 11 feet in depth at mean low-water, or about 16 feet at ordinary high-water, to enable sea-going vessels of a larger class to engage in the transportation of ice, as this depth can be carried through to the ocean.

The estimated cost of the improvement above projected, as revised, is as follows, viz:

Shoal at the head of Swan Island:	
3,600 cubic yards of dredging, at 35 cents	$1,260
Hatch's Rocks Shoal:	
16,000 cubic yards of dredging, at 30 cents	4,800
Shoal at the foot of Swan Island:	
10,000 cubic yards of dredging, at 30 cents	3,000
Wing-dam at the head of Swan Island:	
3,500 tons of rubble-stone, at $1 per ton of 2,240 pounds	3,500
Wing-dam at Hatch's Rocks Shoal:	
5,000 tons of rubble-stone, at $1 per ton of 2,240 pounds	5,000
Adding for engineering expenses and other contingencies	2,440
Total	20,000

By the river and harbor act of March 3, 1881, the sum of $10,000 was appropriated for the improvement of this harbor; and on the 6th of June proposals, as invited, were received for dredging at Hatch's Rocks Shoal and at the shoal near the foot of Swan Island; also, for 3,500 tons of rubble-stone for the wing-dam at the head of Swan Island (as shown in the accompanying tables of proposals received), for which work the following contracts have been made, viz:

1. With Samuel F. Purington, of Brunswick, Me., June 30, 1881, for about 10,000 cubic yards of dredging at Hatch's Rocks Shoal, and about 10,000 cubic yards of dredging at the foot of Swan Island, at 29 cents per cubic yard, measured *in situ*.
2. With James Ginn, of Bath, Me., June 20, 1881, for 3,000 tons of rubble-stone, at $1 per ton of 2,240 pounds, both of which contracts are to be completed before the close of the present season.

Richmond Harbor is situated in the collection district of Bath, Me, of which Bath is the port of entry, and is about 10 miles above Bath on the Kennebec River. The nearest light-houses are Seguin and Pond Island near the mouth of Kennebec River, and the nearest fort is Fort Popham, at the mouth of the Kennebec River, distant about 15 miles below Bath.

The accompanying paper from the United States collector of customs at Bath furnishes a statement of the amount of commerce and navigation that would be benefited by the improvements projected for this harbor, and the tables give a list of proposals received and the contracts made for the work to be done under the appropriation of March 3, 1881.

Money statement.

Amount appropriated by act approved March 3, 1881	$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	19 02
July 1, 1881, amount available	9,980 98
Amount (estimated) required for completion of existing project	10,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	10,000 00

Abstract of proposals received June 6, 1881, for dredging and building a rubble-stone wing-dam, in Kennebec River, at and near Richmond, Me.

Number of reference.	Bidders.	Residence.	Dredging Hatch's Rocks Shoal and foot of Swan Island.	About 3,500 tons of rubble-stone for wing-dam.	Remarks.
1	Sam. F. Purington....	Brunswick, Me..	29 cents per cubic yard *in situ*.	....	20,000 cubic yards, more or less, of dredging.
2	Eastern Dredging Company, by William W. Wright.	Portland, Me ...	31 cents per cubic yard *in situ*.		
3	Robert Hamilton, jr..	Chebeaque Island, Me.	37 cents per cubic yard *in situ*; in scows, 29 cents.		
4	James Ginn	Bath, Me	....	$1 per ton of 2,240 pounds.	Stone along shore of Kennebec River.
5	John F. Hamilton and	Portland, Me ...	....	$1.25 per ton of 2,240 pounds.	Granite grout.
	Joseeph F. Curit.	Cumberland, Me.	....	$1.10 per ton of 2,240 pounds.	Kennebec granite and black stone.
6	Hallowell Granite Company, by William Wilson, treasurer.	Hallowell, Me...	....	$1.58 per ton of 2,240 pounds.	In accordance with specifications.

Abstract of contracts made during the fiscal year ending June 30, 1881, for improvement of Richmond Harbor, Kennebec River, Maine.

Date of contract.	Contractors.	Nature of work.	Price.
1881. June 20	James Ginn, Bath, Me..	3,000 tons, more or less, of rubble-stone to build a wing-dam at the head of Swan Island.	$1 per ton of 2,240 pounds.
June 30	Samuel F. Purington, Brunswick, Me.	Dredging (20,000 cubic yards, more or less) Hatch's Rocks Shoal and shoal near the foot of Swan Island.	29 cents per cubic yard, measured *in situ*.

COMMERCIAL STATISTICS.

CUSTOM-HOUSE, BATH, ME.,
Collector's Office, June 18, 1881.

SIR: As requested by your letter of the 17th instant, I send you the following answer, viz:

1. Amount of revenue collected in year ending 1880:

Duties on imports	$36,462 98
Hospital dues	2,283 10
Tonnage tax	700 20
Steamboat inspection fees	644 15
From other sources	285 74
	40,376 17

2.	Exports	22,574 00
	Imports	81,087 00
	Transported from other districts in bond	74,255 00
		177,916 00
3.	Number of vessels arrived	2,937
	Number of vessels sailed	2,955
	Number of vessels built, 41 ... tons..	22,185.02

About one-half, if not more, of the vessels arriving and clearing pass these points, and would be benefited by the proposed improvements.

I am, very respectfully, your obedient servant,

JOHN H. RAYMOND,
Deputy Collector.

General GEORGE THOM,
Colonel of Engineers.

SURVEY OF RICHMOND HARBOR, ON THE KENNEBEC RIVER, MAINE.

UNITED STATES ENGINEER OFFICE,
Portland, Me., December 10, 1880.

GENERAL: I have the honor to submit the report of an examination of Richmond Harbor, Maine, made under my direction, in November last, by Lieut. William T. Rossell, Corps of Engineers, with a view to its improvement, as called for by act of Congress approved June 14, 1880, "making appropriations for the construction, repair, preservation, and completion of certain public works on rivers and harbors, and for other purposes," the same being accompanied by a sketch showing the proposed improvements.

Kennebec River is here divided by Swan Island into two channels, of which the main channel passes to the eastward of the island, through "the narrows," with a navigable depth of 10 to 11 feet at mean low-water, whilst the western channel, which forms Richmond Harbor, so called, is navigable for the same depth except at the following places, to wit:

1. At the head of Swan Island.
2. At Hatch's Rocks Shoal, about 2 miles below head of island.
3. At the foot of Swan Island, about 5 miles below its head.

The shoal at the head of Swan Island was improved in 1872 by dredging to a depth of 10 feet at mean low-water (or 15 feet at ordinary high-water); but, as was then predicted, it has been reproduced by the same causes as before. For insuring the continuance of its depth, if again dredged, it is recommended that a wing-dam be built out from the upper end of Swan Island, as shown on the sketch, in order to create a greater scour on *the bar* by the diversion into its channel of a part of the water of the main channel.

For a similar purpose a wing-dam is also recommended to be built out from the western shore at Hatch's Rocks Shoal, as shown on the sketch; which, in connection with the projected dredging at that shoal, will, it is believed, insure the desired depth of 10 feet at mean low-water.

At the lower end of this harbor, near the foot of Swan Island, ice-houses have been built and projected to such an extent as to warrant an improvement of the channel at that place by widening and deepening the same where shaded in blue on the sketch. In this locality it is proposed to make the channel not less than 11 feet in depth at mean low-water, or about 16 feet at ordinary high-water, to enable sea-going vessels of a larger class to engage in the transportation of ice, as this depth can be carried through to the ocean.

The estimated cost for the improvement of this third shoal is as follows, viz:

13,600 cubic yards of dredging *in situ*, at 35 cents	$4,760
Adding for contingent expenses, say	714
	5,474
Adopting Lieutenant Rossell's plan and estimates for the dredging and wing-dams at the two upper shoals, as stated in his report herewith	15,026
Total	20,500

The extent to which commerce and navigation would be benefited by the improvements herein proposed is shown by the accompanying correspondence with Hon. E. S. J. Nealley, United States collector of customs at Bath, Me.

Respectfully submitted.

GEO. THOM,
Colonel of Engineers,
Bvt. Brig.-Gen., U. S. A.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF LIEUT. WILLIAM T. ROSSELL, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., December 6, 1880.

COLONEL: In accordance with instructions, dated Portland, Me., November 3, 1880, directing me to make an examination of Richmond Harbor, Maine, I left this office November 4, and returned November 20, 1880. The results of this examination are embodied in the following report, which I have the honor to submit:

The harbor of Richmond, Me., consists of the westerly channel of the Kennebec River, as divided by Swan Island. In length it is about 4½ miles, and in width varies from 600 to 2,000 feet at low-water.

The plane of mean low-water, as determined by the United States Coast Survey, was used in this examination.

The shoals complained of were three in number:

First, or Upper Shoal, near the north end of Swan Island.

Second, or Hatch's Rocks Shoal, near the middle of the harbor.

Third, or Lower Shoal, near the south end of Swan Island.

The shoal near the north end of Swan Island was dredged in 1872, so as to give a channel 150 feet wide and 10 feet deep at mean low-water. Adopting, then, 10 feet as the minimum depth for a channel, I find that at the first, or Upper Shoal, a bar exists 600 feet wide and with an average depth of water of about 8.5 feet at mean low-water. At the second, or Hatch's Rocks Shoal, a bar exists about 2,000 feet wide and with an average depth of water of about 8.7 feet at mean low-water. At the third, or Lower Shoal, a clear channel exists with a minimum width of 100 feet, and a minimum depth of 10 feet.

ESTIMATES OF COST OF OBTAINING A CHANNEL 150 FEET WIDE AND 10 FEET DEEP AT MEAN LOW-WATER.

First, or Upper Shoal, dredging 3,600 cubic yards, at 35 cents	$1,260
Second, or Hatch's Rocks Shoal, dredging 16,000 cubic yards, at 35 cents	5,600
Third, or Lower Shoal, dredging, none.	
Total	6,860
Ten per cent. for superintendence, &c	686
Aggregate	7,546

As the bed of the river consists almost entirely of sand, any channel made by dredging alone would gradually fill up, and the river would regain its original form. A case in point is the channel dredged through the first or Upper Shoal in 1872, where the bar has again formed. Dredging alone, then, gives but temporary relief. In order to obtain a permanent channel the strength of the current must be so directed as to prevent the sand and other material from again collecting. For this purpose wing-dams should be built.

For the first or Upper Shoal, commencing at or near the point marked W in the accompanying sketch, the dam should extend in the direction indicated about 550 feet. In cross-section the dam should be 5 feet wide at the top, with side slopes of 45°, and be built to a height of 3 feet above mean low-water. Exactly the best position for the dam can only be determined by a careful examination of the currents at all stages of the tide.

For the second or Hatch's Rocks Shoal, a wing-dam should be built, commencing near the point marked W in the sketch, and extend, in the direction indicated, a distance of 350 feet, the cross-section and height to be the same as in the dam for first or Upper Shoal. After these dams have been built, the channels, if dredged, would probably be permanent.

ESTIMATE OF COST OF IMPROVEMENT.

Wing-dams:	
First, or Upper Shoal, 3,500 tons of stone, at 80 cents	$2,800
Second, or Hatch's Rocks Shoal, 5,000 tons of stone, at 80 cents	4,000
Dredging both shoals, 19,600 cubic yards, at 35 cents	6,860
Ten per cent. contingencies	1,366
Total	15,026

Very respectfully, your obedient servant,

WM. T. ROSSELL,
First Lieutenant of Engineers.

Col. GEO. THOM,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

CUSTOM-HOUSE, BATH, ME.,
Collector's Office, December 9, 1880.

DEAR SIR: I forward to you herewith a statement of the commerce and navigation between the foot and the head of Swan Island, prepared by Mr. C. H. T. J. Southard, of Richmond, which I believe is substantially correct and to be relied upon.

Very respectfully and truly, yours,

E. S. J. NEALLEY,
Collector.

General GEO. THOM.

LETTER OF MR. C. H. T. J. SOUTHARD.

RICHMOND, ME., *December 7, 1880.*

DEAR SIR: In reply to your inquiry of 3d instant, the amount of business on the Kennebec River between the foot and head of Swan Island for the past year, we estimate:

	Value.
200,000 tons ice shipped	$1,000,000
Lumber, &c., from saw-mills and machine-shops	200,000
Shoe factory	750,000
From ship-yards	200,000
Dry goods, groceries, hardware, agricultural implements, &c., supplies for over 50 firms	450,000
Hay, straw, and country produce sent, and coal brought	200,000
Total	2,800,000

The number of sailing vessels passing up and down by Richmond, or stopping here, we estimate at 1,500 the past year: steam-tugs, 13, passing here 3,000 times during the season; Boston steamer 130 trips; vessels passing other side of the island, 1,500.

Now, there are some 500,000 tons ice-fields between the head and foot of the island (and only 200,000 tons taken up), all first-class in every particular (preferable on account of being near the village to get help), and would all be sold, and permanent ice-houses put up, if there was plenty of water for large vessels to load, but as it is barred at both ends nothing but small vessels of light draught can load here, and they have to wait for high-water to get out when loaded, which causes detention and waste of ice.

There has been 500,000 to 600,000 tons of ice shipped from above the head of the island which would come this way in preference to the east side of the island, this side being safer, if the channel was deepened; for at Lovejoy's Narrows on the east side has been deepened, and being very narrow and crooked passage making a cross tide which causes vessels to sheer and go ashore.

Our tugs have paid considerable damage done by the tide not setting true.

Yours, truly,

C. H. T. J. SOUTHARD.

Hon. E. S. J. NEALLEY,
Collector of Customs, Bath, Me.

A 7.

IMPROVEMENT OF CATHANCE RIVER, MAINE.

The head of navigation of this river is at the bridge at Bowdoinham, Me., from which to its outlet into Merry-Meeting Bay (a distance of about 2⅝ miles) the river has a navigable channel of not less than 19 feet depth at mean low-water, or 24½ feet at mean high-water. From its outlet into the bay the channel continues in an indirect course, with depths varying from 26 to 6 feet at mean low-water, for a distance of about 2⅛ miles to its junction with the main channel of Kennebec River near "The Chops." The principal obstruction to its navigation was found, by the special survey of 1879, to be at "the outer bar," where the channel enters the Kennebec, on the shoalest part of which there was but 6 feet of water at mean low-water, or 11½ feet at mean high-water.

But, owing to the shifting character of this bar, it was not believed that any work, unless attended by a cost too great to be warranted by the object of the improvement, would effect a permanent improvement of the channel at this place. At the other two shoals, lying between "the outer bar" and the outlet of the river into the bay, it is believed that the channel can be widened and deepened in a more effectual and satisfactory manner, as shown on sketch accompanying last annual report.

A channel so located, with a depth of 10 feet at mean low-water (or 15½ feet at mean high-water) for a width of not less than 200 feet, has been projected for the improvement of this river, at an estimated cost of $25,000.

By the river and harbor act of June 14, 1880, the sum of $10,000 was appropriated for this improvement, under which a contract was made August 21, 1880, with Mr. William W. Wright, of Geneva, N. Y.—the lowest of two bidders—for 30,000 cubic yards, more or less, of dredging, at 27 cents per cubic yard, measured *in scows*.

Dredging was commenced under this contract on the 1st of September, and completed on the 8th of November, 1880, resulting in 31,347 cubic yards, whereby the channel was widened and deepened at "the outer bar" to the extent projected, and at the lower portion of bar three, for a width of 100 feet, to a depth of 10 feet at mean low-water.

By the river and harbor act of March 3, 1881, the additional sum of $6,000 was appropriated for the improvement of this river, under which appropriation a contract has been made with the Eastern Dredging Company, of Portland, Me. (the lowest of three bidders), for 25,000 cubic yards, more or less, of dredging, at 21 cents per cubic yard, as measured *in scows*, the dredging to be commenced on or before the 20th of July, and completed on or before the 30th of September, 1881.

By this dredging it is proposed to deepen the channel at the lower portion of bar three for an additional width of about 30 feet, and to deepen the channel of the upper portion of this bar for a width of about 125 feet to the projected depth of 10 feet at mean low-water.

The extent to which the commerce and navigation of the country would be benefited by the improvement of this channel is shown to some extent by the following statement, furnished me through the United States collector of customs at Bath by residents of Bowdoinham, as follows, viz:

> The people interested are the towns of Bowdoinham and Bowdoin, to enable them to ship their cargoes in vessels of large size, and deeper draught of water. The cargoes *outward*, now shipped in schooners and scows, are chiefly spruce lumber, deals, frame stuff, &c., say 2,500,000 feet, which would be doubled, if we could load a ship here, say 1,000 tons ground feldspar rock, 500 tons quartz rock, 100,000 bricks, hay, wood, and bark; *inward*, say 1,000 tons anthracite coal, 500 tons plaster, rock, &c. Since 1850 twenty vessels, having an aggregate of 17,000 tons, have been built on the banks of Cathance River.

It is also stated that a large quantity of ice is cut and stored on this river for shipment; that in 1863 about 50,000 tons were cut and stored, but not all shipped, as vessels of sufficient size could not pass the bar.

The following-named papers are hereto appended, viz:

Two abstracts of proposals received.
Abstract of contracts made.

Money statement.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	6,000 00	
		$16,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		9,459 69
July 1, 1881, amount available		6,540 31
Amount (estimated) required for completion of existing project		9,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		9,000 00

Abstract of proposals received August 17, 1880, *for dredging in Cathance River, Maine.*

Number for reference.	Bidders.	Residence.	25,000 cubic yards dredging.	Remarks.
1	William W. Wright	Geneva, N. Y	27 cents per cubic yard.	As measured in scows.
2	Robert Hamilton, jr., and Solomon Sawyer.	Chebeague Island, Me., Yarmouth, Me.	33 cents per cubic yard.	

Abstract of proposals received June 6, 1881, *for dredging in Cathance River, Maine.*

Number for reference.	Bidders.	Residence.	25,000 cubic yards dredging.	Remarks.
1	Eastern Dredging Company, by Wm. W. Wright, president.	Portland, Me	21 cents per cubic yard.	As measured in scows.
2	Sam F. Purington	Brunswick, Me	27 cents per cubic yard.	
3	Robert Hamilton, jr.	Chebeague Island, Me.	32 cents per cubic yard.	

Abstract of contracts made during the fiscal year ending June 30, 1881, for improvement of Cathance River, Maine.

Date of contract.	Contractors.	Nature of work.	Price.
1880 Aug. 21..	William W. Wright, Geneva, N. Y.	Dredging 30,000 cubic yards, more or less.	27 cents per cubic yard, measured in scows.
1881 June 14..	Eastern Dredging Company, Portland, Me.	Dredging 25,000 cubic yards, more or less.	21 cents per cubic yard, measured in scows.

A 8.

IMPROVEMENT AT THE "GUT" OPPOSITE BATH, MAINE.

The "gut" is a part of Back River, which is a tidal river about 9 miles in length, connecting the Kennebec River at Bath, Me. with the tide-waters of Sheepscot River to the eastward of it. Is is navigable for small steamers and other vessels of light draught, and affords a short communication between Kennebec River and the towns of Westport, Wiscasset, Boothbay, Southport, and other places on or near the waters of the Sheepscot. At the "gut" (or more commonly called "Upper Hell Gate"), which is about 2 miles distant from the city of Bath, the navigation of Back River was very much improved in its difficult places under appropriations made therefor by Congress, in 1870 and 1871, amounting to $16,500, as stated in the Annual Report of 1873, and for its further improvement, the following appropriations have since been made by Congress, viz:

By the river and harbor act of June 18, 1878	$17,000
By the river and harbor act of June 14, 1880	7,000
By the river and harbor act of March 3, 1881	5,000
Total	29,000

These appropriations have been made with a view to opening a navigable channel with a depth of not less than 11 feet at mean low-water above "the Narrows" and 12 feet below "the Narrows" for a width of not less than 90 feet, by the breaking up and removal of the several sunken ledges and shoals by which the channel has hitherto been obstructed.

On referring to the last annual report, with the accompanying sketch showing the improvements then completed and proposed, it will be seen that under the several appropriations made previous to June 14, 1880, all the projected improvements had been completed except the breaking up and removal of the sunken ledges (north of Green Island) marked C and D, the ledge G near Tibbett's Point and the ledge E near the head of "the Narrows."

Under the appropriation of June 14, 1880, a contract was made August 26, 1880, with Mr. James Andrews, of Biddeford, Me. (the lowest of three bidders), for the breaking up and removal of the sunken ledges C and D north of Green Island, aggregating about 175 cubic yards, for the price of $35 per cubic yard, measured *in situ*. About 50 cubic yards of the ledge D have been removed under this contract, and it is expected that the whole contract will be completed before the close of the present season.

Under the appropriation of March 3, 1881, a contract has been made with Mr. George W. Townsend, of Boston, Mass., the lowest of three bidders, for breaking up and removing the sunken ledges E and G, aggregating about 120 cubic yards, for the sum of $36 per cubic yard, measured *in situ*, the work to be commenced on or before the 1st of July, and completed on or before the 30th of November, 1881.

By these contracts all the work now projected for the improvement of this channel will be completed under the appropriations available therefor.

This locality lies in the collection district of Bath, Me., of which Bath is the port of entry, and is distant about 2 miles from Bath. The nearest light-houses are Pond Island and Seguin lights, near the mouth of Kennebec River, and the nearest fort is Fort Popham, at the mouth of that river, and distant about 15 miles.

The following information in regard to the revenue and commerce of the district of Bath, for the year ending December 31, 1880, has been furnished by the United States deputy collector of customs at that port:

Amount of revenue collected	$40,376 17
Value of exports	22,574 00
Value of imports	81,087 00
Value of merchandise transported in bond from other districts	74,255 00
Number of vessels arrived	2,937
Number of vessels sailed	2,955

Number of vessels built, 41; 22,185.02 tons.

The following named papers are hereto appended, viz:

Two abstracts of proposals received.

Abstract of contracts made.

Money statement.

July 1, 1880, amount available	$7,250 69	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$12,250 69
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,551 37	
July 1, 1881, outstanding liabilities	350 00	
		1,901 37
July 1, 1881, amount available		10,348 92

Abstract of proposals received August 17, 1880, *for the excavation of sunken ledges at the "gut" opposite Bath, Me.*

Number for reference.	Bidders.	Residence.	Sunken ledges, about 200 cubic yards.		
			Ledge C.	Ledge D.	Both ledges.
1	James Andrews	Biddeford, Me			$35 per cubic yard, measured *in situ*.
2	Isaac Hamilton and Gardner Floyd.	Portland, Me	$48 per cubic yard, measured *in situ*.	$39 per cubic yard, measured *in situ*.	$43.75 per cubic yard, measured *in situ*.
3	Isaac A. Sylvester	Newton, Mass			$47 per cubic yard, measured *in situ*.

Abstract of proposals received June 6, 1881, *for the excavation of the sunken ledges at the "gut" opposite Bath, Me.*

Number for reference.	Bidders.	Residence.	Sunken ledges, about 120 cubic yards.		
			Ledge E, about 57 cubic yards.	Ledge G, about 63 cubic yards.	Both ledges.
			Per day.	*Per cubic yard.*	*Per cubic yard.*
1	Geo. W. Townsend.	Boston, Mass ...	....	....	$36, measured *in situ.*
2	Isaac Hamilton and Gardner Floyd.	Portland, Me ...	....	....	$38.50 measured *in situ.*
3	James Andrews....	Biddeford, Me..	$40, measured *in situ.*	$40, measured *in situ.*	

Abstract of contracts made during the fiscal year ending June 30, 1881, *for the improvement of the "gut" opposite Bath, Me.*

Date of contract.	Contractors.	Nature of works.	Price.
1880. Aug. 26	James Andrews, Biddeford, Me.	Breaking up and removing sunken ledges C and D, at and near the "gut," 175 cubic yards, more or less.	$35 per cubic yard, measured *in situ.*
1881. June 16	Geo. W. Townsend, Boston, Mass.	Breaking up and removing sunken ledges E (near the head of "the Narrows") and G (near Tibbett's Point), 120 cubic yards, more or less.	$36 per cubic yard, measured *in situ.*

A 9.

IMPROVEMENT OF PORTLAND HARBOR, MAINE.

The work now projected for the improvement of this harbor consists in removing that portion of the middle ground which lies between the main entrance of the inner harbor and the new harbor line *below* Galt Wharf, so as to have a depth of 21 feet at mean low-water, or about 30¼ feet at mean high-water; and from Galt Wharf upwards a depth of 16 feet at mean low-water in front of the wharf lines as far as Portland Bridge.

In the Annual Report for the fiscal year ending June 30, 1880, will be found a history of all the appropriations made and all the work done for the improvement of this harbor up to that period; and that on the 1st of July, 1880, there was available for the further improvement of the harbor, under the appropriations of June 23, 1874, and March 3, 1875, the sum of $40,000. From that report it will also be seen that a channel had been opened for a width of 500 feet through the middle ground to a depth of 21 feet at mean low-water up to the Grand Trunk wharves, and thence up to Merrill's Wharf; that the harbor had been deepened in front of the wharf lines and outward to the main channel to a depth of 16 feet at mean low-water; also, that the further extension of this improvement up the harbor had been prevented by Brown's Wharf, the Boston and Maine Railroad Wharf, and other wharves which were permitted to project far into the harbor, outside the harbor lines, much to the injury of this harbor. As no steps had been taken for the removal of the projecting portions of these wharves, and as there was no probability that any would be taken, it was decided to continue the 16-feet dredging from

Merrill's Wharf up to near Brown's Wharf, and abandon for the present the further improvement of the harbor above. It was also decided to increase the depth of the harbor in front of Atlantic Wharf (above the Grand Trunk wharves) to a depth of 21 feet at mean low-water.

For this purpose proposals were invited, on the 21st of October, 1880, for 40,000 cubic yards, more or less, of dredging, and in response thereto three bids were received and opened on the 10th of November, 1880, the lowest being that of Messrs. George C. Fobes & Co., of Baltimore, Md., with whom a contract was made therefor, at 15¾ cents per cubic yard, measured in scows. This contract was completed on the 22d of April, 1881, by 48,238.7 cubic yards of dredging in completion of the projected improvements at those places, leaving on hand an available balance of about $30,000.

With a view to the further improvement of this harbor by the removal of the middle ground so as to afford present and prospective facilities necessary for ocean steamers, in connection with the Grand Trunk and other railroads centering in Portland from the North and West, the accompanying letter from the mayor and aldermen of the city of Portland, addressed to the United States engineer in charge of the improvement of this harbor, was forwarded by him to the Chief of Engineers, with a special report, which contained an estimate for the removal of the middle ground, as above projected, to a depth of 21 feet above mean low-water, by about 660,000 cubic yards of *dredging*, at an estimated cost of $160,000.

By the river and harbor act of March 3, 1881, the sum of $20,000 was appropriated for that purpose, making the total amount available therefor about $50,000. On the 22d of April proposals were invited for 200,000 cubic yards, more or less, of dredging, and in response thereto two bids were received and opened on the 13th of May, 1881, of which the lowest was that of Messrs. George C. Fobes & Co., of Baltimore, Md., at 17 cents per cubic yard, measured *in scows*. In acceptance of this bid a contract was made, May 14, 1881, for 250,000 cubic yards, more or less, of dredging, to be completed, weather permitting, on or before the 31st of December next. Dredging was commenced on the 16th of June, and during the month 19,518 cubic yards had been removed under that contract.

All the works completed and projected for the improvement of this harbor are in the collection district of Portland and Falmouth, Me., and the nearest forts are Forts Gorges, Preble, and Scammel, and that on Portland Head; the nearest light-houses are, one at the outer extremity of the breakwater, and one at Portland Head.

The following information in regard to the revenue and commerce of this port for the year ending December 31, 1880, has been furnished by the United States collector of customs at the port of Portland, Me.:

Amount of revenue collected	$348,288 42
Value of imports	8,390,341 00
Value of exports	11,633,848 00

	Number.	Tonnage.	Crew.
Arrivals of vessels	846	661,891	14,147
Clearances of vessels	857	625,838	13,883

Number of vessels built in the district	7
Aggregate tonnage of vessels built in the district	4,960.88

The following named papers are hereto appended, viz:

Two abstracts of proposals received.
Abstract of contracts made.
Letter from mayor and aldermen of the city of Portland

Money statement.

July 1, 1880, amount available	$40,000 00	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$60,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	12,967 50	
July 1, 1881, outstanding liabilities	331 81	
		13 299 31
July 1, 1881, amount available		46,700 69
Amount (estimated) required for completion of existing project		110,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		110,000 00

Abstract of proposals received November 10, 1880, *for dredging in Portland Harbor, Maine.*

Number for reference.	Bidders.	Residence.	Dredging about 40,000 cubic yards.		
			In front of Atlantic Wharf, about 16,500 cubic yards.	Above and near Merrill's Wharf, about 25,000 cubic yards.	Both localities.
1	George C. Fobes & Co	Baltimore, Md			15¾ cents per cubic yard, measured in scows.
2	William W. Wright	Geneva, N. Y	35 cents per cubic yard, measured in scows.	23 cents per cubic yard, measured in scows.	
3	Robert Hamilton, jr	Chebeague Island, Me.			29 cents per cubic yard, measured in scows.

Abstract of proposals received May 13, 1881, *for dredging at the Middle Ground in Portland Harbor, Maine.*

Number for reference.	Bidders.	Residence.	Dredging about 200,000 cubic yards.
1	George C. Fobes & Co	Baltimore, Md	17 cents per cubic yard, measured in scows.
2	William W. Wright	Geneva, N. Y	22 cents per cubic yard, measured in scows.

Abstract of contracts made during the fiscal year ending June 30, 1881, *for improvement of Portland Harbor, Maine.*

Date of contract.	Contractors.	Nature of work.	Price.
1880. Nov. 24.	George C. Fobes & Co., Baltimore, Md.	Dredging in front of the Harbor Commissioner's Line near Atlantic and Merrill's wharves, 40,000 cubic yards, more or less.	15¾ cents per cubic yard, measured in scows.
1881. May 14.	George C. Fobes & Co., Baltimore, Md.	Dredging "Middle Ground," 250,000 cubic yards, more or less.	17 cents per cubic yard, measured in scows.

LETTER OF THE MAYOR AND ALDERMEN OF THE CITY OF PORTLAND, ME.

CITY OF PORTLAND, *December* 12, 1880.

DEAR SIR: It is with great satisfaction we learn that you are about to have the much-needed dredging done in our harbor.

The increased size of vessels doing business here has made it an imperative necessity.

The great increase in the size of produce-carrying vessels, and the need of suitable wharfage for the immense craft, render it important that the Portland Harbor, being one of the few ports with sufficient depth of water, should be in a position to obtain its share of the traffic in shipping produce.

Vessels are built and others are in course of construction 600 feet long and of corresponding draught. Wharves are planned for the Grand Trunk Railway Company, to be constructed in our harbor, the terminus of the Grand Trunk Railway, and to complete the facilities for their accommodation largely increased dredging will be required, especially on the Middle Ground.

We therefore respectfully request that you will ask of the proper authorities an appropriation (additional to your unexpended balance) of at least $50,000 for the purpose above stated.

WM. SENTER, *Mayor.*
E. H. SARGENT,
THOMAS HASSETT,
BENJAMIN F. ANDREWS,
J. W. DEERING,
ALBION LITTLE,
CHARLES J. CHAPMAN,
Aldermen of Portland.

General GEO. THOM,
U. S. Engineer Corps.

A 10.

IMPROVEMENT OF RICHMOND'S ISLAND HARBOR, MAINE.

This harbor of refuge is formed by a rubble-stone breakwater connecting the island with the mainland, the breakwater being about 2,000 feet in length, with an average thickness of 30 feet, and a height of 10 feet above mean low-water.

The following appropriations have been made by Congress for this work, viz:

By the river and harbor act approved June 10, 1872	$20,000 00
By the river and harbor act approved March 3, 1873	60,000 00
By the river and harbor act approved March 3, 1875	15,000 00
By the river and harbor act approved June 18, 1878	6,000 00
By the river and harbor act approved March 3, 1879	3,000 00
By the river and harbor act approved June 14, 1880	3,000 00
By the river and harbor act approved March 3, 1881	3,000 00
Total	110,00 00

Under the several appropriations made as above in 1872–'79, an aggregate of about 66,400 tons (gross) of rubble-stone has been furnished, and placed in the breakwater by contracts.

Under the appropriation of $3,000, made by the river and harbor act of June 14, 1880, a contract was made, August 21, 1880, with Messrs. Hiram Hamilton and Reuben S. Smart, of Cape Elizabeth, Me. (who were the lowest of three bidders), at $1.04 per ton of 2,240 pounds, for granite grout, obtained from the "New Meadows quarry," or $1.09 trem the Spruce Head, and other approved quarries in Maine.

On the 4th of December, 1880, this contract was completed, by which 1,826$\frac{1780}{2240}$ tons were furnished and placed in the work.

Under the appropriation of $3,000 made by the river and harbor act of March 3, 1881, for completing this improvement, a contract has been made with Mr. Charles H. Bragdon, of Biddeford, Me. (the lowest of three bidders), for 2,000 tons, more or less, of "Granite Quarry grout" to be furnished and placed in the breakwater, at $1.28 per ton, of 2,240 pounds; the same to be completed on or before the 10th of September, 1881. On the 29th of June, Mr. Bragdon commenced the delivery of stone under his contract.

The harbor formed by this breakwater affords safe anchorage and good holding ground for vessels of the largest class, with the wind from any point except the southwest; and as the winds from the northward and eastward bring the most violent and destructive gales that occur on this coast, there can be no question as to the importance of this work, in affording a refuge for vessels which are prevented by these storms from entering Portland Harbor (12 miles to the eastward) or other places on this part of the coast. The following-named papers are hereto appended, viz:

Two abstracts of proposals received.
Abstract of contracts made.

Money statement.

July 1, 1880, amount available	$3,000 00	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$6,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,907 18
July 1, 1881, amount available		3,092 82

Abstract of proposals received August 17, 1880, for furnishing rubble-stone for breakwater at Richmond's Island Harbor, Me.

Number for reference.	Bidders.	Residence.	2,500 tons rubble-stone.		
			Grout from New Meadows quarry.	Grout from Spruce Head or other quarries in Maine.	Granite grout.
1	Hiram Hamilton and Rueben S. Smart.	Cape Elizabeth, Maine.	$1.04 per ton of 2,240 pounds.	$1.09 per ton of 2,240 pounds.	
2	Joseph F. Curit and Hugh Bowen.	Cumberland, Me			$1.50 per ton of 2,240 pounds.
3	Charles H. Bragdon.	Biddeford, Me			$1.55 per ton of 2,240 pounds.

Abstract of proposals received June 6, 1881, for furnishing "Granite Quarry Grout" for breakwater at Richmond's Island, Harbor Maine.

Number for reference.	Bidders.	Residence.	About 2,500 tons, Granite Quarry grout.
1	Charles H Bragdon	Biddeford, Me	$1.28 per ton of 2,240 pounds.
2	John F. Hamilton and Joseph F. Curit	Portland, Me., Cumberland, Me.	$1.37 per ton of 2,240 pounds.
3	John A. Hamilton	Cumberland, Me	$1.39 per ton of 2,240 pounds.

Abstract of contracts made during the fiscal year ending June 30, 1881, *for improvement of Richmond's Island Harbor, Maine.*

Date of contracts.	Contractors.	Nature of work.	Price.
1880. Aug. 21.	Hiram Hamilton and Reuben S. Smart, both of Cape Elizabeth, Me.	Furnishing and placing granite grout for breakwater, 2,500 tons, more or less: From New Meadows quarry	$1.04 per ton of 2,240 pounds.
		From other Maine quarries	$1.09 per ton of 2,240 pounds.
1881. June 10.	Charles H. Bragdon, Biddeford, Me.	Furnishing and placing Granite Quarry grout for breakwater, 2,000 tons, more or less.	$1.28 per ton of 2,240 pounds.

A II.

IMPROVEMENT OF KENNEBUNK RIVER, MAINE.

By an act of Congress of 1798, provision was made for keeping in repair a pier, built at the mouth of this river, for the improvement of its navigation, and by several subsequent acts, from 1829 to 1852, appropriations amounting to $44,175 were made for continuing the improvements at and near its mouth.

These works consisted of—

1. A stone pier, about 600 feet in length, on the western side of the channel, at the mouth of the river, with a lighthouse (since destroyed by storm) on its outer extremity, and a wooden catch-sand, about 160 feet in length, leading from the inner end of the pier to the eastern bank of the river.

This pier and catch-sand served to protect the entrance from easterly storms, as well as to prevent the sand from being driven into the channel above.

2. A stone pier, about 290 feet in length, on the western side of the channel, at the mouth of the river, with a wooden catch-sand, about 160 feet in length, leading from the inner end of the pier to the western bank of the river, serving a similar purpose to those on the eastern side.

3. A crib-work wharf ballasted with stone, about 300 feet in length, built on the eastern side of the river, about one-eighth of a mile above its mouth, for the security of vessels detained by tides and storms.

Since the completion of the above works, the following additional appropriations have been made by Congress for the improvement of this river, viz:

By act approved July 11, 1870	$5,000
By act approved March 3, 1871	5,000
By act approved August 14, 1876	5,000
By act approved March 3, 1879	2,000
By act approved June 14, 1880	2,000
By act approved March 3, 1881	2,000
Total	21,000

Under the appropriation of 1870 the catch-sand connecting the inner end of the stone pier with the eastern bank of the river, having been destroyed by storms, was replaced by a permanent stone work, and some repairs were made where most necessary on the stone piers and on the wharf above.

Under the appropriation of 1871, the catch-sand, or wing connecting the inner end of the western pier with the western bank of the river, having also been destroyed by storms, was replaced by a permanent stone-work, and additional repairs were made on the piers and wharf.

Under the appropriation of 1876, the main channel of the river was deepened and widened, by dredging at the Wading Place and Mitchell's Point, so as to have a depth of not less than 4 feet at mean low-water, or 13 feet at mean high-water, and repairs were made where most necessary on the piers and government wharf.

Under the appropriations of $4,000 made by the river and harbor acts of 1879 and 1880, the following work has been done for the improvement of this river, to wit:

1. The sunken ledge below Ward's Wharf and those near the mouth of Gooch Creek have been broken up and removed from the channel to a depth of 4 feet below the plane of mean low-water.

This work was commenced on the 14th of June and completed on the 7th of July, 1880, it having been done by a submarine party, with a vessel provided with a steam drill and steam derrick, and a crew, all hired by the day.

2. The channel of the river has been straightened and widened, by dredging, to a depth of not less than 4 feet at mean low-water (*a*) below Ward's Wharf, (*b*) below Lord's Wharf, and (*c*) at the upper part of Mitchell's Point. This was done by employing a dredging-machine, with steam-tug, scows, and crews, all hired by the day, from July 27 to August 20, 1880, at $125 per day.

3. Some repairs have also been made on the government wharf, near the mouth of the river.

By the river and harbor act of March 3, 1881, the sum of $2,000 was appropriated for completing the improvement of this river.

This appropriation is to be applied to completing the repairs of the stone pier at the mouth of the river and the repair of the government wharf, near its mouth, which will probably be completed before the close of the present season.

This river lies in the collection district of Kennebunk, of which Kennebunk is the port of entry.

The following information has been furnished by the United States deputy collector of customs of Kennebunk in regard to the revenue and commerce of that port for the year ending December 31, 1880, viz:

Arrivals and departures of foreign vessels, *none*. About 100 each, arrivals and departures, of domestic vessels. Vessels built, 10; tonnage, 1,746.47 tons, the largest of which measured 1,080.63 tons.

Money statement.

July 1, 1880, amount available	$3,925 17	
Amount appropriated by act approved March 3, 1881	2,000 00	
		$5,925 17
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		3,929 81
July 1, 1881, amount available		1,995 36

A 12.

IMPROVEMENT OF WINNIPISEOGEE LAKE, NEW HAMPSHIRE.

Winnipiseogee Lake and its tributaries lie wholly within the State of New Hampshire, their waters forming the chief source of Merrimac River.

The lake is about 20 miles in length and has an average width of about 5 miles. At its southwestern extremity (at Weirs) it has an outlet into Long Bay, which bay is navigable for a distance of 4 miles to its outlet at Lake Village.

A dam built at Lake Village forms a reservoir of these waters, which is under the control of an incorporated company, by which water-power is regulated and supplied to factories along the Merrimac River below.

These waters are navigated, when not closed by ice, by three or four steamers drawing from 4 to 5 feet of water, and by seven or eight smaller ones of 1 to 3 feet draught. The largest three of these steamers run in connection with the railroads which strike the lake at Alton Bay and Wolfborough at its eastern extremity, and at Weirs at its southwestern extremity, as well as to Centre Harbor at its northwestern extremity; also, through Long Bay to Lake Village. They are chiefly intended and used, from the middle of May to the latter part of November, for the transportation of pleasure travel, whilst the smaller boats are used principally for carrying wood and produce, and occasionally passengers, about the shores of the lake.

The project adopted for the improvement of this lake consists in widening and deepening the shoal at its outlet into Long Bay, so as to enable steamers to pass through this outlet in all stages of the water, it being the only obstacle to extending navigation to Lake Village.

The shoalest water found on this shoal at the time of the survey (in the latter part of August, 1879), when the water was 8½ inches below the top of the dam at Lake Village, was 4.5 feet.

From information obtained at the office of the Winnipiseogee Lake Cotton and Woolen Manufacturing Company at Lake Village, it appears that the *lowest* water known in the lake stood at 48 inches below the top of the dam at that place, whilst the *highest* water known was 18 inches above the top of that dam.

From this it is seen that the depths found by the survey were 39½ inches (or 3.3 feet) greater than would have obtained in the lowest known stages of the water and 26½ inches (or 2.2 feet) lower than in its highest stages.

The depth of water required for such steamers as would be likely to navigate Long Bay in running to Lake Village, as stated to me by parties interested therein, would be about 5 feet, to obtain which depth in the lowest stages of the water would call for a depth of 8.3 feet, as measured in the stage which it had in August last when the survey was made.

The estimated cost of the dredging required for this improvement is $7,500, for which the following appropriations have been made by Congress, viz:

By the river and harbor act of June 14, 1880	$5,000
By the river and harbor act of March 3, 1881	2,500
Total	7,500

Under the appropriation of June 14, 1880, proposals were three times invited for this work, in response to which none were received the first time and only one the second time, which was rejected for being too high as well as informal.

The third time one bid only was received, to wit, that of the Winnipiseogee Lake Cotton and Woolen Manufacturing Company, at $1 per cubic yard, measured *in situ*. A contract was made with that company on the 16th of November, 1880, for 4,450 cubic yards, more or less, of the dredging, the same to be completed on or before the 1st of September, 1881.

Under this contract dredging operations were commenced on the 1st of June and continued throughout the month, resulting in about 400 cubic yards of dredging to date.

Under the appropriation of March 3, 1881 (as above), a contract has been made with the same company, which was the only bidder, for completing all the remaining dredging projected for this improvement (viz, about 2,800 cubic yards) at $1 per cubic yard, measured *in situ*, the same to be completed this present season.

The following-named papers are hereto appended, to wit:

Two abstracts of proposals received.
Abstract of contracts made.

Money statement.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	2,500 00	
		$7,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		104 35
July 1, 1881, amount available		7,395 65

(No proposals received on the 17th. day of August, 1880, for dredging in Winnipiseogee Lake, New Hampshire, in response to advertisement dated July 27, 1880.)

Abstract of proposals received September 30, 1880, *for dredging in Winnipiseogee Lake, New Hampshire.*

Number for reference.	Bidders.	Residence.	About 7,200 cubic yards.	Remarks.
1	John S. Wadleigh and Thomas Pearsons.	Weirs, N. H.; Methuen, Mass.	$1.50 per cubic yard, measured by the survey *in situ*.	Rejected as being too high, as well as informal.

Abstract of proposals received November 10, 1880, *for dredging in Winnipiseogee Lake, New Hampshire.*

Number for reference.	Bidders.	Residence.	About 7,200 cubic yards.
1	The Winnipiseogee Lake Cotton and Woolen Manufacturing Company, by Jotham P. Hutchinson, their agent.	Lake Village, N. H.	$1 per cubic yard, measured by the survey *in situ*.

Abstract of proposals received June 6, 1881, *for dredging in Winnipiseogee Lake, New Hampshire.*

Number for reference.	Bidders.	Residence.	About 2,800 cubic yards.
1	The Winnipiseogee Lake Cotton and Woolen Manufacturing Company, by Jotham P. Hutchinson, their agent.	Lake Village, N. H.	$1 per cubic yard, measured by the survey *in situ*.

Abstract of contracts made during the fiscal year ending June 30, 1881, for dredging in Winnipiseogee Lake, New Hampshire.

Date of contracts.	Contractors.	Nature of work.	Price.
1880. November 16.	The Winnipiseogee Lake Cotton and Woolen Manufacturing Company, by Jotham P. Hutchinson, their agent.	Dredging channel at outlet of the lake, 4,450 cubic yards, more or less.	$1 per cubic yard, as measured by the survey *in situ*.
1881. June 17.	The Winnipiseogee Lake Cotton and Woolen Manufacturing Company, by Jotham P. Hutchinson, their agent.	Dredging channel at outlet of the lake, 2,800 cubic yards, more or less.	$1 per cubic yard, as measured by the survey *in situ*.

A 13.

IMPROVEMENT OF LAMPREY RIVER, BELOW NEW MARKET, NEW HAMPSHIRE.

This river empties into Great Bay at a point about 10 miles distant, by water, from Portsmouth, N. H. It is navigable at high-water from its mouth up to New Market wharves at the head of tide-water, a distance of about 2½ miles. The mean rise and fall of the tides at its mouth is about 6½ feet, and at New Market about 6 feet. From its mouth up to the Lower Narrows (a distance of 1¾ miles) the channel has a navigable depth of 12 feet at mean high-water, but is obstructed in several places by large sunken bowlders and by the Point of Flats at its mouth, whereby the channel is so contracted and crooked as to be difficult and dangerous. Above the Lower Narrows the channel has a navigable depth of not more than 9 feet at mean high-water, in its shoalest places, and is moreover much obstructed by sunken bowlders and projecting ledges which should be removed to insure safe navigation.

From a survey of this river made in August, 1874, the following estimate was made of the cost of improving its channel so as to have a navigable depth of 12 feet at mean high-water from its mouth up to the Lower Narrows for a width of not less than 100 feet; and thence up to the wharves of New Market, a depth of 11 feet at mean high-water for a width of not less 40 feet, to wit:

Dredging 5,700 cubic yards of sand and gravel, at 50 cents per cubic yard	$2,850 00
Removal of 617 cubic yards of ledge and hard pan, with bowlders, at $25 per cubic yard	15,425 00
Removal of 1,084 tons of loose bowlders, at $2.50 per ton	2,710 00
Contingencies, say	3,015 00
Total	24,000 00

By the river and harbor act of March 3, 1881, the sum of $10,000 was appropriated for the improvement of this river, which is to be applied to the removal of sunken bowlders and ledges, and arrangements have been completed for commencing this work on the 1st of July, with a probability that the work will be completed, to the extent practicable with this appropriation, on or before the close of the fiscal year.

As to the extent to which the commerce of the country would be benefited by the improvement of this river as projected, it will be seen on referring to the special report of December 5, 1874, that New Market then had forty stores, four large cotton factories (the largest of which is driven by steam), one iron machine-shop, one steam lumber-mill, and within about 2 miles, two large paper-mills which draw their materials and supplies from New Market. New Market and the immediate vicinity consumes, annually, about 5,000 tons of coal, which comes largely by water from Portsmouth, and would entirely, if the navigation of the river were improved as proposed. In addition to which, lime, salt, iron, plaster, cement, fish, and other heavy articles are also brought to New Market by water, while wood, hay, and lumber in large quantities, annually, are taken back to Portsmouth and other places along the coast.

Lamprey River lies within the collection district of Portsmouth, N. H., of which Portsmouth is the port of entry, and the nearest light-houses and forts are at and near the entrance of that harbor.

Money statement.

Amount appropriated by act approved March 3, 1881	$10,000 00
July 1, 1881, amount expended during fiscal year	8 75
July 1, 1881, amount available	9,991 25
Amount (estimated) required for completion of existing project	14,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	14,000 00

A. 14.

IMPROVEMENT OF EXETER RIVER, NEW HAMPSHIRE.

Exeter River is navigable from its mouth in Great Bay (where it meets Lamprey River, about 10 miles above Portsmouth, N. H.) for a distance of about 8.3 miles, up to the wharves of Exeter, the head of tide-water.

The mean rise and fall of the tides at its mouth is about 6½ feet, and at Exeter about 6 feet.

By the survey of it, made in 1874, it was found that the channel could be much improved in several places by the removal of sunken rocks and shoals, and by a short cut-off at the Ox-bow, near Exeter, so as to obtain a depth of not less than 12 feet, at mean high-water, from its mouth up to the Ox-bow, and thence up to Gilman's Wharf in Exeter, a depth of not less than 10 feet.

For the improvement of this river as above projected the following appropriations have been made by Congress, to wit:

By the river and harbor act of June 14, 1880	$20,000
By the river and harbor act of March 3, 1881	15,000
Total	35,000

Under the appropriation of June 14, 1880, proposals were invited September 13, 1880, for the dredging above Fernald's Wharf in Exeter, in response to which only one bid was received, which, being unreasonably high, was not accepted.

Under the joint appropriations of June 14, 1880, and March 3, 1881, proposals were again invited May 2, 1881, for all the *dredging* projected for the improvement of this river (to wit, 47,000 cubic yards, more or less), and three bids were received therefor, of which the lowest was that of Thomas Symonds, of Everett, Mass. (see abstract of proposals herewith), at prices as follows, to wit:

5,000 cubic yards, more or less, above Fernald's Wharf, at $1.06 per cubic yard, measured *in situ*.

25,000 cubic yards, more or less, at the Ox-bow Cut-off, at 46 cents per cubic yard, measured *in situ*.

17,000 cubic yards, more or less, at South New Market, and below, at 47 cents per cubic yard, measured *in situ;* or 41 cents per cubic yard, measured *in scows*.

On the 21st of May a contract was made with Mr. Symonds for the dredging at the prices named, the same to be completed on or before the 15th of December, 1881.

On the 13th of June dredging was commenced by him under his contract, at Exeter.

By the river and harbor act of March 3, 1881, provision was made for the purchase (at a cost not to exceed $750) of a right of way for the projected cut-off at the Ox-bow, the purchase of which was effected after some difficulty, on the 28th of May last. On the 1st of June a *deed* of the same was sent to the Chief of Engineers, for the action of the United States Attorney-General, and as soon as approved the excavation of the cut-off will be commenced, under the contract of May 21.

In the latter part of May a submarine party, with two scows and crews and the requisite hoisting and drilling apparatus, commenced work at South New Market, N. H., for the removal of sunken rocks from the channel, and on the 30th of June nearly all of them were removed to the extent projected, whereby the channel has been much improved.

This work has been done by hiring the diving party, and others employed, by the day.

By the contemplated improvement of this river the manufacturing towns of South New Market and Exeter, N. H., will be much benefited. They both lie upon the river, and are distant by water from Portsmouth, N. H. (the port of entry), respectively, about 15 and 19 miles.

South New Market is a thriving village, and has a very large iron machine-shop and foundry, in which are manufactured a great many steam-engines and castings. About 4,000 tons of coal are used there annually, as well as a large amount of iron and casting sand, which are brought there by water from Portsmouth, a distance of about 15 miles.

Exeter is also a thriving village of about 3,650 inhabitants. It has a large machine-shop and foundry, and several other manufacturing concerns, with some forty stores, also a very large cotton factory, driven to a great extent by steam. It is estimated that 5,000 tons of coal are used there annually, which, with other heavy articles, are carried there by water from Portsmouth. Large quantities of hay, fruit, and potatoes are also shipped from these river towns to Boston and other places further south.

In the transportation of coal, it costs about $1 per ton extra for its transshipment in gondolas and small vessels at Portsmouth, which would be saved if brought direct to these river towns, and so with all the heavy freight for the cotton-mills, foundries, and other manufactories on and near this river.

The following named papers are hereto appended, to wit:

Two abstracts of proposals received.
Abstract of contracts made.

Money statement.

July 1, 1880, amount available	$20,000 00	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$35,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,072 92	
July 1, 1881, outstanding liabilities	954 00	
		3,026 92
July 1, 1881, amount available		31,973 08

Abstract of proposals received September 30, 1880, *for dredging in Exeter River, New Hampshire.*

Number for reference.	Bidders.	Contractors.	Dredging from Fernald's Wharf up to Gilman's Wharf, about 5,200 cubic yards.	Remarks.
1	William W. Wright	Geneva, N. Y.	$1.35, measured *in situ*.	Rejected as too high and not being prepared to complete dredging this season.

Abstract of proposals received May 20, 1881, *for dredging in Exeter River, New Hampshire.*

Number for reference.	Name of bidders, with residence.	From Fernald's Wharf up to Gilman's Wharf, about 5,000 cubic yards.	Cut-off at the Ox-bow, about 25,000 cubic yards.	South New Market and below, about 17,000 cubic yards.
1	Thomas Symonds, Everett, Mass.	$1.06, measured *in situ*.	46 cents, measured *in situ*.	47 cents, measured *in situ*; 41 cents, measured in scows.
2	William W. Wright, Geneva, N. Y.	$1.23, measured *in situ*; 98 cents, measured in scows.	60 cents, measured *in situ*; 48 cents, measured in scows.	48 cents, measured *in situ*.
3	Robert Hamilton, jr. Chebeague Island, Maine.		55 cents, measured *in situ*.	50 cents, measured *in situ*.

Abstract of contracts made during the fiscal year ending June 30, 1881, *for improvement of Exeter River, New Hampshire.*

Date of contract.	Contractor.	Nature of work.	Price per cubic yard.
1881. May 21.	Thomas Symonds, Everett, Mass.	About 47,000 cubic yards of dredging:	
		From Fernald's Wharf up to Gilman's Wharf, 5,000 cubic yards, more or less.	$1.06, measured *in situ*.
		At the cut-off at the Ox-bow, 25,000 cubic yards, more or less.	46 cents, measured *in situ*.
		At South New Market and below 17,000 cubic yards, more or less.	47 cents, measured *in situ*, or measured in scows 41 cents, as may be optional with the United States Engineer in charge of the work.

A 15.

IMPROVEMENT OF PORTSMOUTH HARBOR, NEW HAMPSHIRE.

The work originally projected for the improvement of this harbor consisted of—

1. *A rubble-stone breakwater* for closing the side-channel between Great Island and Goat Island near the "Third Bridge" so as to stop the strong tidal current through it, by which vessels coming up the harbor were liable to be thrown upon Goat Island Ledge, which projects far into the channel, here very narrow, thereby creating one of the greatest difficulties encountered in entering this harbor.

2. *Breaking up and removing Gangway Rock*, lying in the channel between "South Beacon Shoal" and the navy-yard. The shoalest part of

this rock has but 12 feet of water on it at mean low-water, and 20½ feet at mean high-water, and only 9.7 feet at *extreme* low-water of spring tides. Owing to the strong tidal currents in this harbor Gangway Rock has proved to be a serious difficulty to navigation, and especially so to United States vessels which have visited this port and the navy-yard, as well as to other vessels of large draught. It is projected to remove this rock to a depth of 20 feet at mean low-water (making 28½ feet at mean high-water), especially in the interests of United States vessels, a greater depth not having been adopted on account of the great increase of cost attending it.

This improvement would increase the width of the channel for the projected depth about 370 feet, which would be of great benefit to this part of the harbor.

3. *The removal in part of the ledge at the southwest point of Badger's Island.*—This ledge projects into the channel about 150 feet, where it has only about 4 feet of water at mean low-water. It thereby presents serious difficulties to vessels coming down the harbor on the ebb-tide, which, after passing Nobles Island, and in their endeavors to avoid being thrown by the powerful current upon the projecting point of Portsmouth, opposite Badger's Island, are very liable to be, and often have been, thrown upon the point of ledge which projects from Badger's Island. To prevent this difficulty it is projected to remove this ledge, for a length of 135 feet, to a depth of 10 feet at mean low-water, which would give 7.7 feet at extreme low-water of spring tides.

For the improvements projected as above the following estimates of cost have been submitted, to wit:

1. For the breakwater between Goat Island and Great Island	$12,600
2. Breaking up and removing Gangway Rock to a depth of 20 feet at mean low-water, 2,840 cubic yards, at $30 per cubic yard	85,200
3. Breaking up and removing ledges at the southwest point of Badger's Island, 1,190 cubic yards, at $30 per cubic yard	35,700
Adding for engineering expenses, superintendence, and other contingencies, say	16,500
Total	155,000

The following appropriations have been made by Congress for the improvement of this harbor, to wit:

By the river and harbor act of March 3, 1879	$10,000
By the river and harbor act of June 14, 1880	25,000
By the river and harbor act of March 3, 1881	20,000
Total	55,000

Under the appropriation of March 3, 1879, a contract was made August 27, 1879, for 12,200 tons of rubble-stone for the projected breakwater, at 69 cents per ton of 2,240 pounds (the lowest of nine bids for the same). This contract was completed on the 31st of May, 1880, by which the breakwater was built throughout its entire length of 785 feet to height of about 2 feet above the plane of mean high-water.

Under the appropriation of June 14, 1880, a contract was made, August 20, 1880, with Messrs. Curit & Bowen, of Cumberland, Maine, for additional rubble-stone for this work, at 77 cents per ton of 2,240 pounds (the lowest of four bids for the same), under which contract about 2,400 tons of rubble-stone were placed on the work in completion of the same, on the 24th of November, 1880.

Under the appropriation of June 14, 1880, a contract was also made, August 23, 1880, with Mr. Isaac A. Sylvester, of Newton, Mass. (the lowest of six bidders), for breaking up and removing 700 cubic yards, more or less, of Gangway Rock, at $27.90 per cubic yard, measured *in situ*, the contract to be completed on or before the 31st of December, 1881. Owing to difficulties arising from the strong tidal currents at this place, and to the special preparations that have, in consequence thereof, been found necessary, operations were not commenced for the removal of this rock until about the 1st of April, 1881, since which time about 100 cubic yards of the rock have been broken up and removed to grade.

Under the appropriation of March 3, 1881, proposals are to be invited as soon as practicable for additional work on Gangway Rock.

The several works above projected are located in the collection district of Portsmouth, of which Portsmouth, N. H., is the port of entry. The nearest light-houses are Portsmouth Harbor Light and Whalesback Light, at the outer entrance of the harbor. The nearest forts are Fort McClary and Fort Constitution in the lower harbor. The United States navy-yard at Kittery, Me., is also in this harbor.

The following information as to the revenue and commerce of the port of Portsmouth, N. H., for the year ending December 31, 1880, has been furnished by the United States collector of customs at that place, to wit:

Amount of revenue	$17,972 49
Value of imports	18,456 00
Value of exports	2,428 00

	Number.	Tonnage.
Foreign arrivals and departures	20	1,914
Domestic arrivals and departures	705	128,467
Fishing vessels	475	15,645

The following named papers are hereto appended:

Abstract of proposals received.
Abstract of contracts made.

Money statement.

July 1, 1880, amount available	$25,011 46	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$45,011 46
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,322 61	
July 1, 1881, outstanding liabilities	279 00	
		4,601 61
July 1, 1881, amount available		40,409 85
Amount (estimated) required for completion of existing project		95,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		55,000 00

Abstract of proposals received August 17, 1880, for furnishing rubble-stone for breakwater in Portsmouth Harbor, New Hampshire.

Number for reference.	Bidders.	Residence.	About 2,000 tons granite grout.
	Joseph F. Curit and Hugh Bowen	Cumberland, Me	77 cents per ton of 2,240 pounds.
2	Joseph R. Holmes	Portsmouth, N. H	98½ cents per ton of 2,240 pounds.
3	Isaac Hamilton and Gardner Floyd	Portland, Me	$1 per ton of 2,240 pounds.
4	Joseph H. White	Hyde Park, Mass	$1.04 per ton of 2,240 pounds.

Abstract of proposals received August 17, 1880, *for removal, in part, of Gangway Rock, in Portsmouth Harbor, New Hampshire.*

Number for reference.	Bidders.	Residence.	About 700 cubic yards sunken ledge.
1	Isaac A. Sylvester	Newton, Mass	$27.90 per cubic yard measured *in situ*.
2	George W. Townsend	Boston, Mass	$39 per cubic yard measured *in situ*.
3	James Andrews	Biddeford, Me	$40 per cubic yard measured *in situ*.
4	George L. and Hiram W. Phillips	Quincy Point, Mass	$40 per cubic yard measured *in situ*.
5	Charles A. Trumbell	Lawrence, Mass	$42.37 per cubic yard measured *in situ*.
6	Isaac Hamilton and Gardner Floyd	Portland, Me	$47 per cubic yard measured *in situ*.

Abstract of contracts made during the fiscal year ending June 30, 1881, *for the improvement of Portsmouth Harbor, New Hampshire.*

Date of contract.	Contractor.	Nature of work.	Price.
1880. Aug. 20.	Joseph F. Curit and Hugh Bowen, both of Cumberland, Me.	For furnishing and placing 2,000 tons, more or less, of rubble-stone on breakwater which connects Great Island and Goat Island.	77 cents per ton of 2,240 pounds.
Aug. 23.	Isaac A. Sylvester, Newton, Mass.	Breaking up and removing, in part, Gangway Rock, in Portsmouth Harbor, 700 cubic yards, more or less.	$27.90 per cubic yard measured *in situ*.

A 16.

IMPROVEMENT OF NEWBURYPORT HARBOR, MASSACHUSETTS.

The following appropriations have been made by Congress for the improvement of this harbor, to wit:

By the river and harbor act of June 14, 1880	$50,000 00
By the river and harbor act of March 3, 1881	40,000 00
Total	90,000 00

After a careful survey of the "outer bar" and entrance to this harbor, made in July and August, 1880, with a view to the improvement of the same, it was ascertained, on comparing the results of this survey with surveys of the same locality made by the United States Coast Survey in 1851 and in 1878, as well as with one made by the United States Government in 1827, that great changes had taken place in the position and extent of the extremities of Plum Island and Salisbury Beach, and that the main channel on the "outer bar" had been moving northwardly, having had in 1851 an outward course of 16° south of east; in 1878, due east; and in 1880, 12° north of east; also, that in 1851 this channel had a least depth of 6 feet; 1878, of 7 feet; and in 1880, of 7½ feet, at mean low-water, the mean rise and fall of the tides being 7½ feet. This comparison of surveys also showed that the 12 and 18-feet curves at the outer edge of the bar (where it falls rapidly into deep water) have had during that period almost identically the same positions, at the distance of about 1 mile from the present harbor entrance.

Current observations made in 1880 showed that the maximum velocity at the mouth of the river (or harbor) between Plum Island and Salisbury Beach, at mid-depth, was about 3 miles an hour, on the average ebb-tide; and that outside the bar the littoral current varied from 0.2 to 0.66 mile per hour, moving northward on the *flood*-tide, and from 0.06 to 0.5 mile per hour, moving northward and eastward on the *ebb*-tide.

From numerous borings made in 1880, it appears that the "outer bar" consists of soft mud and loose sand, overlying coarse and hard sand and fine gravel.

In order to give a permanent location to this channel over the "outer bar," and to secure a constant depth of 13½ feet across the bar at mean low-water, or 21 feet at mean high-water, a project was submitted by me to the department in September last, which has been approved, after having been referred to the Board of Engineers for River and Harbor Improvements.

This project consists of two converging rubble-stone jetties, built out from the shore north and south of the entrance, to an extent sufficient for accomplishing the object in view (as shown on the accompanying drawing); the jetties to be built to a height of 4 feet above mean high-water, with a width of 15 feet on top, and with inner slopes of 45°, and outer slopes of 1: 2.

The estimated cost of these jetties, together with a shore protection on the north end of Plum Island (should it become necessary), is as follows, viz:

North jetty, 170,000 tons, at $1.32 per ton	$224,400 00
South jetty and shore protection on Plum Island, 80,000 tons, at $1.32 per ton	105,600 00
Adding for engineering expenses and all other contingencies, say	35,000 00
Total	365,000 00

This increased estimate is owing to the greatly increased cost of stone and freighting during the past year.

Under the appropriation of $50,000, made by the river and harbor act of June 14, 1880, for the improvement of this harbor, a contract was made December 24, 1880, with Mr. Frederick A. Ingerson, of Haverhill, Mass. (the lowest of four bidders), for 50,000 tons, more or less, of rubble-stone, to be placed in the northern jetty, at 83 cents per ton of 2,240 pounds.

After encountering many unexpected difficulties, due to adverse winds and a sudden rise in the cost of stone and freighting same, the contractor felt compelled to abandon the work.

Proposals were again invited, April 30, 1881, for this work, under the appropriation of March 3, 1881, in response to which three bids were received, of which the lowest was, on an average, about $1.48 per ton of 2,240 pounds. This was deemed unreasonably high and was not accepted.

Proposals were again invited, June 3, for 65,000 tons of rubble-stone under the joint appropriation of June 14, 1880, and March 3, 1881, aggregating (as above) $90,000, in response to which six bids were received and opened on the 21st of June (see abstract herewith), of which the lowest was that of Mr. Edward P. Shaw, of Newburyport, Mass., at $1.32 per ton of 2,240 pounds; at which price a contract has been made with him for 60,000 tons, more or less, furnished and placed in the work, the delivery of the stone to be commenced on or before the 15th of July, and completed in 1882.

Newburyport Harbor lies in the collection district of Newburyport, Mass., of which Newburyport is the port of entry.

The nearest light house is on Plum Island at the entrance to the harbor.

EN
Whistle Buoy
Section
H.W.
L.W.
Jetty P.O.

The following information in regard to the revenue and commerce of the port of Newburyport, Mass., for the year ending December 31, 1880, has been furnished by the United States deputy collector of customs at that port, to wit:

Amount of revenue collected		$2,472 46
Value of imports		10,940 92
Value of exports		2,725 00
Arrivals, foreign	number..	29
Departures, foreign	"	35
Arrivals, domestic	"	429
Departures, domestic	"	405

Vessels built, 7; tonnage, 358.44.

The following named papers are hereto appended, to wit:

Drawing showing plan and location of the projected jetties.
Three abstracts of proposals.
Abstract of contracts made.

Money statement.

July 1, 1880, amount available	$50,000,000	
Amount appropriated by act approved March 3, 1881	40,000,000	
		$90,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,585 82
July 1, 1881, amount available		87,414 18
Amount (estimated) required for completing existing project		275,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		100,000 00

Abstract of proposals received December 6, 1880, *for furnishing rubble-stone for the projected jetty on Salisbury Beach, on north side of entrance to Newburyport Harbor, Massachusetts.*

Number for reference.	Bidders.	Residence.	50,000 tons, more or less, granite quarry grout.
1	Frederic A. Ingerson	Haverhill, Mass	$0.83 per ton of 2,240 pounds.
2	Isaac A. Sylvester	Newton, Mass	$1.22½ per ton of 2,240 pounds.
3	Joseph H. White	Hyde Park, Mass	$1.33 per ton of 2,240 pounds.
4	Charles H. Bragdon	Biddeford, Me	$2.68 per ton of 2,240 pounds.

Abstract of proposals received May 17, 1881, *for furnishing rubble-stone for the projected jetty on Salisbury Beach, on the north side of entrance to Newburyport Harbor, Massachusetts.*

Number for reference.	Bidders.	Residence.	40,000 tons granite quarry grout.	
			Main work, 35,000 tons, more or less.	Shore extension, 5,000 tons, more or less.
1	Charles H. Bragdon.	Biddeford, Me	$1.38 per ton of 2,240 pounds.	$2.10 per ton of 2,240 pounds.
2	Isaac A. Sylvester*.	Newton, Mass	$1.66 per ton of 2,240 pounds.	$1.66 per ton of 2,240 pounds.
3	Charles W. Parker.	Rockport, Mass.	$1.55 per ton of 2,240 pounds.	$2.50 per ton of 2,240 pounds.

* Will furnish 80,000 tons for $1.52 per ton.

Abstract of proposals received June 21, 1881, for furnishing rubble-stone for the projected jetty on Salisbury Beach, on the north side of entrance to Newburyport Harbor, Massachusetts.

Number for reference.	Bidders.	Residence.	About 65,000 tons rubble-stone.	Remarks.
1	Edward P. Shaw	Newburyport, Mass	$1.32 per ton of 2,240 pounds.	Stone from quarries at Rockport and "Piper's Quarry" at Newburyport, Mass.
2	Charles H. Edwards	Quincy, Mass	$1.39½ per ton of 2,240 pounds. $1.17½ per ton of 2,240 pounds.	Granite quarry grout. 10,000 tons, more or less, of river stone (small).
3	James M. Andrews	Biddeford, Me	$2.05 per ton of 2,240 pounds. $1.33 per ton of 2,240 pounds.	For shore extension. For main work.
4	Isaac A. Sylvester	Newton, Mass	$1.57½ per ton of 2,240 pounds.	Granite quarry grout.
5	Charles W. Parker	Rockport, Mass	$1.62 per ton of 2,240 pounds.	Granite quarry grout.
6	Joseph H. White & Co.	Boston, Mass	$1.74 per ton of 2,240 pounds. $1.69 per ton of 2,240 pounds.	Granite quarry grout. 55,000 tons granite quarry grout and 10,000 tons river stone.

Abstract of contracts made during the fiscal year ending June 30, 1881, for the improvement of Newburyport Harbor, Massachusetts.

Date of contract.	Contractors.	Nature of work.	Price.
1880. Dec. 24	Frederic A. Ingerson, Haverhill, Mass.	Furnishing and delivering 50,000 tons, more or less, of quarry stone, known as granite grout, for the projected jetty on Salisbury Beach.	83 cents per ton of 2,240 pounds.
1881. June 23	Edward P. Shaw, Newburyport, Mass.	Furnishing and delivering 60,000 tons, more or less, of granite grout from quarries at Rockport, Mass., or else from the "upper quarry" on Merrimac River, known as the "Piper Quarry," for the main work and shore protection of the projected jetty on Salisbury Beach.	$1.32 per ton of 2,240 pounds.

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., October 26, 1880.

SIR: I beg leave to submit herewith a project received from Col. George Thom, Corps of Engineers, for the application of the appropriation of $50,000 by act of June 14, 1880, for improving harbor at Newburyport, Mass., and also a report of October 4, 1880, from the Board of Engineers for Fortifications and for River and Harbor Improvements, to which this project was referred for consideration.

The object is to deepen the bar channel at the entrance to the same depth as can now be carried from the bar to Newburyport.

Colonel Thom submits two projects, one of parallel jetties of rubble-stone extending to deep water over the bar, to cost about $390,000; another of converging jetties, also of rubble-stone, costing about $240,000, and gives their location on the accompanying maps. He recommends converging jetties as, in his opinion, more efficacious and as less costly. The Board also advises converging jetties, but is of opinion that in order to secure at all times, especially during storms, the navigable low-water depth of 13½ feet, an actual depth of 17 feet will be needed, and therefore, that the jetties should be further advanced into deep water than proposed by Colonel Thom, but leaves their precise location to the judgment of the local engineer. This modification would, however, increase the cost $240,000 to about $300,000.

Colonel Thom further suggests that the first work to be undertaken should be the protection from abrasion of the extremities of Salisbury Point and Plum Island, which form the entrance to the harbor, the cost of which he estimates at $30,000.

The Board, on the other hand, recommends the application of the appropriation at once to the commencement of the north jetty, for the reason that although there is little doubt these points will eventually require protection, it may perhaps not be judicious to use for that purpose the greater part of the appropriation now available; since their immediate protection does not appear imperative, and the commencement of the north jetty will not probably change essentially the conditions existing at the outlet. At the same time a portion of the funds should be reserved for any contingent work that the result of the winter storms may indicate as required to insure their protection.

I beg leave, therefore, to recommend that the system of converging jetties be adopted for this improvement, and that Colonel Thom be instructed to commence with the north jetty and be governed in the location and prosecution of the work by the recommendations of the Board.

Very respectfully, your obedient servant,

H. G. WRIGHT,
Chief of Engineers,
Brig. and Bvt. Maj. Gen.

Hon. ALEXANDER RAMSEY,
Secretary of War.

[First indorsement.]

The recommendation of the Chief of Engineers is approved.
By order of the Secretary of War.

H. T. CROSBY,
Chief Clerk.

WAR DEPARTMENT,
October 28, 1880.

REPORT OF THE BOARD OF ENGINEERS.

OFFICE OF BOARD OF ENGINEERS FOR FORTIFICATIONS AND FOR RIVER AND HARBOR IMPROVEMENTS, &C.,
New York, October 4, 1880.

GENERAL: The Board of Engineers for Fortifications and for River and Harbor Improvements to whom was referred by department letter of September 21, 1880, the project of General George Thom, for the application of the appropriation of $50,000, made by the river and harbor act of June 14, 1880, for improving the harbor of Newburyport, Mass., have the honor to submit the following report:

The Merrimac River empties into the Atlantic about midway between

Cape Ann and Portsmouth Harbor, in a direction nearly east. Across its outlet is a sand-bar formed by the rolling in of the coast sands by the ocean waves. With the winds from the north around to east the movement of the sands is southward along the shore, while south to east winds produce a northern movement. These contrary movements would soon fill the outlet and join Plum Island with Salisbury Beach, forming a continuous coast line, were it not for the scouring power of the outflowing water of the river, increased by the tidal supply due to a large interior basin and a mean rise and fall of nearly 8 feet. This constant action, on the one hand to form a continuous coast line, and on the other to extend the deep water of the outlet into the ocean, leaves as a resultant of their contrawise effects a bar outside of the mouth of the river, the deepest water across which varies somewhat in position at different seasons of the year, and slightly in depths with changes in the relative power of the opposing forces.

On the bar at mean low-water there is a depth of about 7 feet, while at the outlet the mid-channel carries 30 feet of water for a length of 1,300 feet, the 12-foot curve extending 2,500 feet into the sea beyond Salisbury Point. The distance across the bar upon which the water is shoaler than in the river channel above (13½ feet) is about 3,000 feet. The project before the Board is to deepen this bar channel so that as large-draught vessels may enter the river as can reach Newburyport. The great depth (exceeding 30 feet) of the outlet, which is 1,000 feet wide, and the extension of the 12-foot curve seaward indicate the powerful tidal scour there, and that the living force of the outflowing current in spite of its partial dispersion is sufficient to extend this scouring effect far beyond the contracted water-way. Hence, to obtain 13½ feet depth at mean low-water across the bar, it will not be necessary to confine the current between jetties extended to that depth. This point is fully set forth by General Thom in his explanation of his two projects for deepening the entrance to the Merrimac now before us for consideration and report thereon. His first project (see his report with accompanying plans A and B), proposes the prolongation of the narrow outlet between Salisbury and Plum Island points by parallel jetties 1,000 feet apart, to extend seaward beyond those points from 2,500 to 3,000 feet or to such distance as shall be found effective in opening a 13½-foot channel across the bar.

General Thom, as his second method of effecting the same end, proposes the use of converging jetties (shown on plans A and C), and further recommends the latter for adoption in preference to the former. As the bar at the mouth of the Merrimac does not extend far from the shore, is not formed by deposit of river sediment, and needs for the purposes of navigation only about one-half of the present depth at the outlet, converging jetties will as effectively secure the end desired as parallel ones. Further, as tending to lessen the effect of waves rolling in during storms by giving room for their lateral dispersion, and facilitating the ingress and exit of sailing vessels, and as being much the less costly construction, they are preferable. This Board, therefore, recommends their application at this locality, with the following remarks and suggestions:

It is understood that 13½ feet is the greatest draught that can be carried up the river to Newburyport at mean low-water. It is therefore desirable that the same draught vessels should be able to enter the Merrimac at the same stage of the tide. But, unless the wind has been blowing off shore for a sufficiently long period to break down the ocean swell, and during all in-shore winds, and especially during storms, the waves in the bar channel beyond the jetty ends, and even within them, will not permit vessels to enter drawing the channel depth. It will doubtless require a mean low-tide depth of 17 feet to secure that end, and advancement of the jetties as indicated on plan A by pencil lines P O′ and M N′, with the parallel extensions O′ S and N R′. But such changes will increase the estimate to about $400,000.

We present this view of the case to show how largely the cost of construction is affected by a small additional depth to the channel, due principally to the fact that the extensions required must be built in deep water. It seems from an examination of plan A (see comparison of lines X Y and X′ Y′, in pencil) that the jetties P O and M N of General Thom's plan will not secure a constant depth of channel of 13½ feet, reaching entirely across the bar. Whether to effect that purpose the extensions O O′ and N N′, suggested by him as a possibility, be added to the converging jetties P O and M N, or these latter be advanced as indicated by lines P O and M N, the estimate should be increased to about $300,000. It is quite possible that a position intermediate between the two for the northern and southern jetties, with shorter parallel extensions, may be preferable to those marked on the plan. The exact location, however, may well be left to the engineer officer in charge of this improvement. There can be little doubt that the north end of Plum Island and Salisbury Point, notably the former, against which ebb-tide impinges at a large angle, will require protection. Whether or not it will be judicious to commence operations, using the greater part of the appropriation now available at those points, this Board has not the data to decide. If the local engineer, from his observations or his knowledge of the past changes in the abrasion of those shores, is satisfied that their immediate protection is requisite to preserve them from serious injury, there would seem to be no other course to be pursued; but the fact of commencing the north jetty will not probably change essentially existing conditions at the outlet. At any rate, if the north jetty is first commenced as recommended, a portion of the funds should be reserved for any contingent work that the result of the winter storms may indicate to secure Salisbury and Plum Island points.

Respectfully submitted.

Z. B. TOWER,
Colonel of Engineers, Bvt. Maj. Gen.
JOHN NEWTON,
Colonel of Engineers, Bvt. Maj. Gen.
HENRY L. ABBOT,
Lieut. Col. of Engineers, Bvt. Brig. Gen.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

PROJECT OF COL. GEORGE THOM, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., September 16, 1880.

GENERAL: I have the honor to report the completion of the survey of the entrance to the harbor of Newburyport, Mass., made with a view to its improvement by means of jetties and otherwise; by which survey all the information deemed necessary has been obtained in regard to the depths, the currents, and the character of the material of the "outer bar" as shown on the accompanying drawing marked A.

On comparing this drawing with surveys of the same locality made by the United States Coast Survey in 1851 and 1878, as well as with one made by the United States Government in 1827, it will be seen that great changes have taken place in the location and extent of the extremities of Plum Island and Salisbury Beach, and that the main channel over the "outer bar" has been moving continually to the northward; that in 1851 this channel had a direction, outward, of 16 degrees south of east; in 1878, a direction due east; and in 1880, 12 degrees north of east; also, that in 1851 this channel had a least depth of 6 feet; in 1878 of 7 feet; and in 1880 of 7½ feet, at mean low-water; the mean rise and fall of the tides being 7½ feet.

This comparison also shows that in those years the 12 and 18-foot curves of this channel at the outer edge of the bar (where it falls abruptly into deep water) have occupied almost identically the same positions, at a distance of about 1 mile from the present harbor entrance at Salisbury Point.

Current observations made every 15 minutes for 12 consecutive hours in mid-channel at the mouth of the river (or harbor), between Salisbury Point and Plum Island show that the maximum velocity, at mid-depth, is about 3 miles an hour on the average ebb-tide. Observations made outside of the bar, also every 5 minutes for 12 consecutive hours, at a depth of 15 feet, show a littoral current varying from 0.2 to 0.66 mile per hour, moving northward on the *flood-tide*, and from 0.06 to 0.5 mile per hour moving northward and eastward, on the ebb-tide; and it is probably chiefly owing to this prevailing northward current that the bar channel has been moving continually northward, from year to year. On examining the chart of this coast, it is seen that the winds from the northward and eastward have a more extended and unbroken sweep along the coast towards the entrance of Newburyport Harbor than those from the southward, limited as the latter are by the projecting coast at Cape Ann, about 11 miles distant. It is therefore not improbable that the littoral currents, under the influence of violent northerly storms, may have *at times* a southward direction and thereby move the bar-channel in that direction.

Borings, 68 in number, have been made in and near the present bar-channel of which 12 were made in mid-channel, varying in depths from 12 to 18 feet at mean low-water. These borings show that the "outer bar" consists of soft, loose sand overlying coarse and hard sand and fine gravel—a material which would easily be scouredby the ebb-tide current at the outlet of the harbor (if extended outwards by jetties), and afterwards carried northward by the littoral current.

In order to prevent the continual changes in the bar-channel, and to make its location permanent, as well as to give greater depth (to wit, not less than 13½ feet at mean low-water, or 21 feet at mean high-water), it is proposed to build two rubble-stone jetties out from Salisbury Beach and Plum Island—two being proposed for the following reasons, to wit: first, to prevent the movement of the littoral sands into the channel, either northward or southward, as the current or winds might prevail; second, to confine and thereby increase the scouring effect of the ebb-tide; and third, to afford a safe harbor after entering the head of the jetties. For this purpose, two projects are herein submitted for the consideration of the department, as shown by the accompanying sketches marked B and C, when superimposed upon the map A.

The first project consists (see drawings A and B) in building the jetties out from the extremities (K) of Plum Island and (F) of Salisbury Point, due east to the points respectively marked L and G, distant

1,000 feet apart, the present width of the outlet of the harbor. The distance to which it might become necessary, ultimately, to extend them could be definitely determined by their effective operation in the course of their construction. On referring to the accompanying map A, it is seen that the channel has the desired depth of 13½ feet at mean low-water, or 21 feet at mean high-water, for a distance of 2,300 feet eastward of reference line III–IV at the outlet of the harbor; and thence to the same depth of water over the bar is an additional distance of 3,000 feet, the bar-channel having in its shoalest part only 7½ feet of water at mean low-water, or 15 feet at mean high-water. On the supposition that the scouring action of the ebb-tide will continue to deepen the channel out beyond the heads of the jetties for at least the same distance and depth that it now does beyond Salisbury Point (to wit, 2,300 feet) it will probably be found sufficient to extend the two jetties outward for a distance not exceeding 3,000 feet from the reference line III–IV for making and maintaining a channel over the bar of the projected depth, viz, 21 feet at mean high-water.

Exposed as these jetties would be to violent easterly storms, it is proposed to build them of rubble-stone, with a cross-section of not less than the following dimensions, viz: the *northern* jetty to have a width of 15 feet on top (the top to be not less than 2 feet above extreme high-water, or 12 feet above mean low-water) with an exterior (northern) slope of 1 foot rise to 2 feet base; and its interior slope, where least exposed, to be 45°, and at its outer end where exposed to southeasterly storms to be 1:2.

Owing to the cropping out of the ledges known as Badger's Rocks inside of Salisbury Point, it is proposed to extend the *northern* jetty around Salisbury Point to the westward as far as the point marked E so as to cover those rocks now dangerous to navigation, and give a more positive direction and action to the ebb-current where it is now split up and weakened in passing through those rocks, as well as to preserve Salisbury Point from abrasion.

In the construction of the *southern* jetty it is proposed to connect its outer end with the shore of Plum Island by a wing (see sketch B), in order to prevent the destructive effect of storms by their concentrated force in the pocket between the jetty and the shifting shore of Plum Island, the dimensions of the wing (L M) to be the same as those of the northern jetty, on account of its greatly exposed position. As this wing will, in a great measure, break the force of the sea upon the *southern* jetty, it is proposed to build the latter only up to mean high-water with a width of 5 feet on top and with inner and outer slopes of 45°, except at the outer end, where exposed to northeast gales, it should have its inner (northern) slope 1:2. It is also proposed to extend the western end of the *southern* jetty as far as the point marked H, for the protection and preservation of the shore, as well as to give a more fixed direction to the tidal currents.

The *second* project consists in building two jetties out from point P on Salisbury Beach, and point M on Plum Island to the points marked O and N respectively, as shown on the accompanying drawings A and C, the jetties to have a cross-section of 15 feet in width on top (the top to be 12 feet above mean low-water), with outer slopes of 1:2 and inner slopes of 45°.

In connection with these jetties it is proposed to build at the extremities of Salisbury Point and Plum Island, works like those described in the first project, for protecting the shores and giving a fixed and proper direction to the tidal currents. In this (second) project it is also proposed to locate the heads of the jetties further to the eastward than in the first project, in order to compensate for the less direct and concentrated action of the tide. Should it be found necessary to extend and increase this tidal action, which is not probable, the two jetties could be extended eastward in parallel directions.

The estimated cost of each of the above-described projects is as follows, to wit:

FIRST PROJECT (PARALLEL JETTIES).

	Cubic yds.
North jetty: Cubic contents, less 20 per cent. for void space	125,000
South jetty: Cubic contents, less 20 per cent. for void space	70,000
Total	195,000
Or 390,000 gross tons.	
The estimated cost of which, at 90 cents per ton is	$351,000
Adding for engineering expenses, and all other contingencies, say	39,000
Total	390,000

SECOND PROJECT (CONVERGING JETTIES).

	Cubic yds.
North jetty, including shore protection on southern extremity of Salisbury Point: Cubic contents, less 20 per cent. for void spaces	82,200
South jetty, including shore protection on the northern extremity of Plum Island: Cubic contents, less 20 per cent. for void spaces	38,550
Total	120,750
Or 241,500 gross tons.	
The estimated cost of which, at 90 cents per ton is	$217,350
Adding for engineering expenses, and all other contingencies, say	22,650
Total	240,000

In the above estimates, allowance has been made for the settling of the rubble-stone 4 feet into the soft sand, wherever it rests upon it. The great facilities offered by the extensive granite quarries along the coast of Cape Ann, have also been considered in the estimated *cost* of the stone.

Of the two projects now submitted that of the converging jetties is recommended for adoption, for the following reasons, to wit:

1. For being less costly ($150,000 less);
2. In affording a more effectual protection to the extremities of Plum Island and Salisbury Point, by obviating the dangerous pockets of the first project; and
3. In affording a safe harbor to vessels on entering the heads of the jetties, and enabling sailing vessels to beat up into the main harbor without danger of running upon the jetties, to which they would be liable in the parallel system.

In the construction of the proposed jetties it is respectfully recommended that the first taken in hand should be the *completion* of the *shore protection* at the extremities of Salisbury Point and Plum Island, the cost of which is estimated at about $30,000.

It is also recommended that the northern jetty should be built next in order, from its shore end outward, so as to protect the northern part of Plum Island from northeast storms, by which it would be much endangered—loose and shifting as its sands are—in the pocket which would there be formed if the southern jetty should be built first.

In building the northern jetty first the same objection would not arise in making a pocket there, as the shore and land of Salisbury Beach is of a much more permanent and unchanging character, and much less liable to injury from southeast storms, than at Plum Island.

Very respectfully, your obedient servant,

GEO. THOM,
Colonel of Engineers,
Bvt. Brig. Gen., U. S. A.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

A 17.

IMPROVEMENT OF MERRIMAC RIVER, MASSACHUSETTS.

The present project for the improvement of this river was adopted in 1870, and modified in 1874, the object being to afford a channel of navigable width, and a depth of not less than 9 feet at mean low-water (or about 16½ feet at mean high-water) from its mouth, at the outlet of Newburyport Harbor, up to Deer Island Bridge, a distance of about 5 miles, and thence up to Haverhill Bridge (an additional distance of 12½ miles) a depth of 12 feet at ordinary *high*-water, the rise and fall of tides varying from 7½ to 4 feet; and thence up to the head of the "Upper Falls" (an additional distance of 4 miles) a depth of not less than 4½ feet in the ordinary stages of the river with the mill-water at Lawrence running, the rise and fall of the tide varying from 4 feet at Haverhill to 0 at the foot of the "Upper Falls."

The natural channel of this river was very narrow and crooked in several places and much obstructed by sunken ledges, bowlders, and shoals; and especially at "The Falls," portions of which were covered with bowlders and ledges more or less bare, and impassable for any vessels or scows; whilst in Newburyport Harbor the channel was obstructed by numerous sunken ledges, crib-work piers, and wrecks, seriously endangering navigation.

Previous to July 1, 1880, the work done for the improvement of this river consisted in opening the channel above Haverhill and through "The Falls" to the projected width and depth, in places where absolutely necessary to make its navigation practicable; also, in dredging at Haverhill, between the bridges, and at Silsby's Island Shoals, as well as at Currier's Shoal (about 4 miles below Haverhill), and at Rocks Bridge (6¾ miles below Haverhill), including the removal of a large number of dangerous sunken rocks at and near Rocks Bridge and the head of Silsby's Island; also, in Newburyport Harbor, in the partial removal of Gangway Rock and North Rocks, and in the removal of a sunken wreck.

For these improvements, the following appropriations have been made by Congress, to wit:

By acts from July 11, 1870, to June 18, 1878, inclusive	$132,000 00
By river and harbor act of March 3, 1879	5,000 00
By river and harbor act of June 14, 1880	12,000 00
By river and harbor act of March 3, 1881	9,000 00
Total	158 000 00

Of the above appropriations there was available on the 1st of July, 1880, the sum of $15,442.05, which has all been applied to the improvement of this river, as follows, to wit:

I. AT AND NEAR ITS MOUTH IN NEWBURYPORT HARBOR.

Under a contract made with Mr. James Andrews, of Biddeford, Me., the only bidder for *completing* the removal (commenced in 1870) of

Gangway Rock, at $30 per cubic yard, measured *in situ*, this work was completed by him between the 11th of September and the 8th of October, 1880, whereby the rock was broken up and removed to a depth of 9 feet below the plane of mean low-water, or 16.7 feet at mean high-water, requiring the removal of 22½ cubic yards of ledge above that plane.

A submarine party, with a sloop provided with suitable steam-drills and hoisting apparatus, was also employed by the day in the removal of the following obstructions in Newburyport Harbor, to wit:

First. Six sunken piers and one sunken scow lying directly across the main channel one-half a mile above its mouth at Salisbury Point. These piers had about 5 feet of water over them at mean low-water, and were built of crib-work, and ballasted with stone; and it is said they were placed there in 1812 and previous thereto, in order to prevent the entrance of hostile vessels into the harbor. By means of the submarine parties, two of these piers and one scow were discovered during these operations. These piers and scow were all broken up, and removed to a depth of not less than 9 feet at mean low-water.

Second. The wreck of the schooner Greyhound, sunk in November, 1879, was broken up and removed from the main channel at the entrance of the harbor.

Third. A large sunken rock (ledge) lying in mid-channel between the north and south piers was broken up and removed to a depth of 12 feet at mean low-water, containing altogether about 6½ cubic yards; and other shoal points of ledge situated in the main channel near North Rocks and the mouth of the river were in part broken up and removed. These submarine operations were carried on between the 28th of July and the 11th of September, and afterwards between the 9th and 31st of October, 1880.

II. AT AND NEAR "THE FALLS" ABOVE HAVERHILL, AND AT ROCKS BRIDGE, 6¾ MILES BELOW HAVERHILL.

Under a contract made in 1879 with the Pentucket Navigation Company for the removal from the channel at the "Lower Falls" of 95¼ cubic yards of sunken ledge, at $30 per cubic yard, measured *in situ*, this channel has been completed to its full projected width and depth. This work was commenced in September, 1879, and completed on the 25th of October, 1880.

For the further improvement of the channel at "The Falls" and Rocks Bridge, a dredging machine and scows (specially adapted to this work), with full crews for the same, were hired by the day at $75 per working day of ten hours. Dredging operations were commenced at the "Upper Falls" on the 30th of July, and continued to the foot of the "Lower Falls" till the 2d of November; during which period the channel at the "Upper Falls" was straightened, widened, and deepened where necessary for the completion of the same. The channel at the "Lower Falls" and below was also deepened, widened, and straightened, and, with the aid of a diving party, a very large quantity of ledge and bowlders was broken up and removed from the channel throughout the whole extent of "The Falls." The unusually low state of the river this season facilitated these operations to a degree seldom to be experienced, and for this reason they were continued until stopped by a rise of water. On the 10th of November the dredging-machine and diving party were transferred to Rocks Bridge, where they were employed until the 20th of November in deepening the channel and in removing numerous large bowlders, by which navigation had been much endangered at that place.

By the operations above described the navigation of the river has been very much improved during the past season. But more work still remains to be done, especially in the removal of sunken rocks at "The Falls," at Rocks Bridge, and in Newburyport Harbor, for effecting all the improvements necessary.

In the completion of all the work that remains to be done for the improvement of this river, as now projected, from the head of "The Falls" above Haverhill down to its mouth at Plum Island Point, the cost is estimated as follows, viz:

1. Removing sunken rocks and shoals in "The Falls" above Haverhill	$1,500
2. Deepening and removing sunken rocks from the channel at Rocks Bridge (6¼ miles below Haverhill)	2,000
3. Completing the breaking up and removal of North Rocks near the mouth of the river in Newburyport Harbor to a depth of 9 feet at mean low-water—150 cubic yards, at $30 per cubic yard	4,500
4. Breaking up and removing the ledge known as "The Boilers" (in front of the wharves near the custom house) to a depth of 5 feet at mean low-water, 350 cubic yards, at $25 per cubic yard	8,750
5. Breaking up and removing South Gangway Rock in Newburyport Harbor to a depth of 9 feet at mean low-water, 120 cubic yards, at $27 50 per cubic yard (as contracted for)	3 300
6. Breaking up and removing South Badger Ledge in Newburyport Harbor to a depth of 10 feet at mean low-water, 50 cubic yards, at $44 per cubic yard (as contracted for)	2,200
7. Breaking up and removing, to a depth of 9 feet at mean low-water, North Rock Spur, 13 cubic yards, at $44 per cubic yard (as contracted for)	572
8. Survey of Merrimac River from Lawrence, Mass., to Manchester, N. H., called for by the river and harbor act of March 3, 1881, and as ordered by the department	800
Adding for engineering expenses, superintendence, and other contingencies, say	3,378
Total	27,000
Amount appropriated by the river and harbor act of March 3, 1881	9,000
Additional amount required for completing all the work now projected for the improvement of this river	18,000

Under the appropriation of March 3, 1881, the following contracts have been made for completing the work described in items 5, 6, and 7 above, to wit:

1. With Mr. Geo. W. Townsend of Boston, Mass., June 17, 1881, the lowest of three bidders for the breaking up and removal of 120 cubic yards, more or less, of South Gangway Rock, in completion of same, at $27 50 per cubic yard, measured *in situ*, the same to be completed on or before the 31st of October, 1881,* amounting to	$3,300 00
2. With Messrs. Trumbull & Cheney, of Boston, Mass., June 20, 1881, the lowest of three bidders for the breaking up and removal of South Badger Ledge (50 cubic yards) and North Rock Spur (13 cubic yards), aggregating 63 cubic yards, more or less, at $44 per cubic yard, measured *in situ*, amounting to	2,272 00
Of the balance of this appropriation there is to be applied to the survey of the river from Lawrence, Mass., to Manchester, N. H., the sum of	800 00
And to contingent expenses and work for the partial improvement of the river, as above projected, the sum of	2,628 00
Total	9,000 00

Merrimac River, up as far as Haverhill, lies in the collection district of Newburyport, Mass., of which Newburyport is the port of entry. The nearest light-house is on Plum Island, at the mouth of the river.

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* Operations were commenced under this contract on the 30th of June, 1881.

The following information in regard to the revenue and commerce of the port of Newburyport, Mass. (at the mouth of Merrimac River), for the year ending December 31, 1880, has been furnished by the United States deputy collector of customs at that port, to wit:

Amount of revenue collected		$2,472 46
Value of imports		10,940 92
Value of exports		2,725 00
Arrivals, foreign	number	29
Departures, foreign	do	35
Arrivals, domestic	do	429
Departures, domestic	do	405

Vessels built, 7; tonnage, 358.44.

The following papers are hereto appended, to wit:

Three abstracts of proposals.
Abstract of contracts made.

Money statement.

July 1, 1880, amount available	$15,442 05	
Amount appropriated by act approved March 3, 1881	9,000 00	
		$24,442 05
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		15,469 52
July 1, 1881, amount available		8,972 53
Amount (estimated) required for completion of existing project		18,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		18,000 00

Abstract of proposals received August 17, 1880, *for removal of a portion of Gangway Rock (Newburyport Harbor), in Merrimac River, Massachusetts.*

Number for reference.	Bidders.	Residence.	About 25 cubic yards.
1	James Andrews	Biddeford, Me	$30 per cubic yard, measured *in situ*.

Abstract of proposals received June 6, 1881, *for breaking up and removing South Gangway Rock (Newburyport Harbor,) in Merrimac River, Massachusetts.*

Number for reference.	Bidders.	Residence.	About 120 cubic yards.
1	Geo. W. Townsend	Boston, Mass	$27.50 per cubic yard, measured *in situ*.
2	Isaac Hamilton and Gardner Floyd	Portland, Me	$37 per cubic yard, measured *in situ*.
3	Charles A. Trumbull and Ethan R. Cheney	Boston, Mass	$38 per cubic yard, measured *in situ*.

Abstract of proposals received June 6, 1881, for removal of two sunken ledges (Newburyport Harbor), in Merrimac River, Massachusetts.

Number for reference.	Bidders.	Residence.	About 63 cubic yards, measured *in situ*.	
			South Badger Ledge, about 50 cubic yards.	North Rock Spur, about 13 cubic yards.
1	Trumbull & Cheney	Boston, Mass	$44 per cubic yard, measured *in situ*.	$44 per cubic yard, measured *in situ*.
2	Geo. W. Townsend	Boston, Mass	$47 per cubic yard, measured *in situ*.	$47 per cubic yard, measured *in situ*.
3	Isaac Hamilton and Gardner Floyd	Portland, Me	$48 per cubic yard, measured *in situ*.	$48 per cubic yard, measured *in situ*.

Abstract of contracts made during the fiscal year ending June 30, 1881, for improvement of Merrimac River, Massachusetts.

Date of contract.	Contractors.	Nature of work.	Price per cubic yard.
1880. Aug. 26.	James Andrews, Biddeford. Me.	Breaking up and removing the remaining portion of Gangway Rock, 22½ cubic yards, more or less.	$30, measured *in situ*.
1881. June 17.	Geo. W. Townsend, Boston, Mass.	Breaking up and removing South Gangway Rock, 120 cubic yards, more or less.	$27.50, measured *in situ*.
June 20.	Trumbull & Cheney, Boston, Mass.	Breaking up and removing South Badger Ledge (50 cubic yards) and North Rock Spur (13 cubic yards) aggregating 63 cubic yards, more or less.	$44. measured *in situ*.

A 18.

IMPROVEMENT OF BOSTON HARBOR, MASSACHUSETTS.

For the several works projected in 1866, and since, for the improvement of Boston Harbor, including those in Hingham Harbor, Mystic River, Charles River, and the channel leading to Nantasket Beach, the following sums have been appropriated by Congress, viz:

By acts from March 2, 1867 to March 3, 1879	$1,271,000
By act approved June 14, 1880 ($30,000 to be expended in Boston Harbor; $22,500 at the mouth of Charles River in said harbor, and up to Watertown; $17,500 at the mouth of Mystic River in said harbor; and $5,000 from said harbor to Nantasket Beach)	75,000
By act approved March 3, 1881 ($40,000 to be expended in said harbor; $35,000 at the mouth of Charles River in said harbor and up to Watertown; $20,000 in said harbor at mouth of Mystic River; and $5,000 from said harbor to Nantasket Beach)	100,000
Total	1,446,000

The unexpended balance of the above appropriations available July 1, 1880, was	$91,698 92
Amount expended during fiscal year ending June 30, 1881, including outstanding liabilities	61,461 70
Total amount available July 1, 1881	130,237 22

During the fiscal year ending June 30, 1881, the following work has been done for the improvement of this harbor, to wit:

I. BOSTON HARBOR (PROPER.)

1. Under the appropriation of $50,000 made by the river and harbor act of March 3, 1879, a contract was made, August 29, 1879, with the New England Dredging Company, of Boston, Mass., the lowest of two bidders, for (*a*) 38,000 cubic yards, more or less, of dredging at Anchorage Shoal, for obtaining a depth of 23 feet at mean low-water, at 74 cents per cubic yard, measured *in situ;* and (*b*) 6,000 cubic yards, more or less, of dredging at the Lower Middle Shoal, to the same depth as above, at 84 cents per cubic yard, measured *in situ.*

Operations were commenced under this contract at Anchorage Shoal on the 15th of September, 1879, and continued up to the 17th of December, 1879, when they were suspended for the winter; they were resumed on the 19th of April and continued up to the middle of June, resulting in 21,054 cubic yards of dredging, measured *in situ*, under said contract.

Operations were then commenced at the Lower Middle Shoal, and were continued up to the 15th of August, 1880, when they were resumed at Anchorage Shoal. This contract was completed on the 22d of September, 1880, under which a total of 27,556 cubic yards of dredging (*in situ*) was done at Anchorage Shoal, by which the channel was opened for a width of 550 feet to a depth of 23 feet at mean low-water, and a total of 5,007 cubic yards of dredging (*in situ*) was done at the Lower Middle Shoal, for obtaining a width of 600 feet to a depth of 23 feet at mean low-water.

Under the appropriation of $30,000 made by the river and harbor act of June 14, 1880, for the harbor proper, a contract was made, August, 27, 1880, with Messrs. Moore & Wright, of Portland, Me., the lowest of four bidders, for 65,000 cubic yards, more or less, of dredging at Anchorage Shoal, at 39 cents per cubic yard, measured *in scows*, under which contract 23,907½ cubic yards of dredging has been done up to include June 30, 1881, and it is expected that the contract will be completed during the present season.

Under the appropriation of $40,000 made by the river and harbor act of March 3, 1881, proposals are to be invited, as soon as practicable, for completing all the projected dredging at Anchorage Shoal, for which it is believed that the amount now available will be sufficient.

The estimated cost of the additional work that remains to be done in this harbor (proper) is as follows to wit:

1. Building in part the sea-wall on Rainsford Island (built in 1840)	$4,500
2. Repair of sea walls on Great Brewster, Lovell's, Gallop's, and Long islands.	6,500
3. Widening main ship-channel at Upper Middle, at its western end; 20,000 cubic yards of dredging, at 50 cents per cubic yard	10,000
Adding for engineering expenses and other contingencies, say	3,000
Total	24,000

II. CHARLES RIVER, BOSTON HARBOR, MASSACHUSETTS.

The project for the improvement of this river is based on surveys made in 1879 and 1880 from its mouth up to the head of tide-water at Watertown, a distance of about 9¾ miles. This project, as modified, consists of straightening, widening, and deepening its channel; *first*, from its mouth up to Western Avenue Bridge (a distance of about 4¾ miles), to a depth of not less than 7 feet at mean low-water (or about 17 feet at mean high-water), for a width of 200 feet; *second*, from Western Avenue Bridge up to Market Street Bridge (an additional distance of about 3¼ miles), to a depth of not less than 6 feet at mean low-water (or about 16 feet at mean high-water), for a width of 80 feet; and, *third*, from Market Street Bridge up to the dam at the head of tide-water (an additional distance of about 1¾ miles), to a depth of 2 feet at mean low-water for a width of 60 feet.

The estimated cost of this improvement, based upon the prices of existing contracts, is	$125,000
Aggregate amount of appropriations made therefor by the river and harbor acts of June 14, 1880, and March 3, 1881, as above stated, is	57,500
Additional amount required for completion	67,500

Under the appropriation of $22,500 made by the river and harbor act of June 14, 1880, for the improvement of Charles River, a contract was made, August 27, 1880, with Messrs. Moore & Wright, of Portland, Me., the lowest of four bidders, for 50,000 cubic yards, more or less, of dredging below Brookline Bridge, at 39 cents per cubic yard, measured *in scows.* Dredging was commenced under this contract in November, 1880, and has been continued to date (when not interrupted by ice), resulting in 33,114 cubic yards of dredging under that contract, with the probability that the contract will be completed not later than the end of September next.

Under the appropriation of $35,000 made by the river and harbor act of March 3, 1881, for this river, a contract was made, June 14, 1881, with the Eastern Dredging Company, of Portland, Me., the lowest of three bidders, for 100,000 cubic yards, more or less, of dredging, at 37 cents per cubic yard, measured *in situ*—operations to be commenced at once. Under this contract the channel will be completed up to Market Street Bridge for a width of about 80 feet to a depth of 6 feet at mean low-water, or 16 feet at mean high-water.

The cost of completing the channel from Market Street Bridge up to the dam at Watertown (1¾ miles) for a width of 60 feet, and to a depth of 2 feet at mean low-water (or about 12 feet at mean high-water), is estimated as follows, to wit:

150,000 cubic yards of dredging, at 40 cents per cubic yard	$60,000
Adding for engineering expenses and other contingencies, say	7,500
Total, as above stated	67,500

III. MYSTIC RIVER.

Under the appropriation made for this river by the river and harbor act of March 8, 1879, the channel near its mouth (in front of the navy-yard) was dredged to a depth of 23 feet at mean low-water for a width of about 125 feet. This work was done by contract and was completed in March, 1880.

Under the appropriation of $17,500 made therefor by the river and harbor act of June 14, 1880, a contract was made, August 27, 1880, with Messrs. Moore & Wright, of Portland, Me., the lowest of five bidders, for 50,000 cubic yards, more or less, of dredging at 29 cents per cubic yard, measured *in scows.*

Operations were commenced under this contract in November, 1880, and completed June 30, 1881, resulting in 48,343 cubic yards of dredging under said contract. By this dredging the channel has been opened to a depth of 23 feet at mean low-water, for an average additional width of about 125 feet, making its total *average* width about 250 feet.

Under the appropriation of $20,000 made by the river and harbor act of March 3, 1881, for this river, a contract was made, June 14, 1881, with the Eastern Dredging Company, of Portland, Me., the lowest of two bidders, for 80,000 cubic yards, more or less, of dredging, at 22 cents per cubic yard, measured *in scows*, the same to be completed March 31, 1882. By this contract all the work projected for the improvement of this river will be completed.

IV. NANTASKET BEACH CHANNEL.

Under the appropriation of $5,000 made by the river and harbor act of June 14, 1880, a survey was made in September and October, 1880, in order to ascertain the object and extent of the improvement for which this appropriation was made, and the project based upon this survey consists of widening and deepening the channel leading to the beach by dredging and rock excavation, so as to have for a width of not less than 100 feet a depth of 9½ feet at mean low-water, or about 19¼ feet at mean high-water. On the 13th of December, 1880, a contract was made with Mr. Robert Hamilton, jr., of Chebeague Island, Me., the lowest of three bidders, for 15,000 cubic yards, more or less, of dredging, at 18¾ cents per yard, measured *in scows*. This contract was completed on the 24th of May, 1881, by 21,924 cubic yards of dredging, whereby the channel was opened for a width of about 70 feet with the projected depth.

The estimated cost of the completion of this channel, as now projected, is as follows, to wit:

1. 30,000 cubic yards of dredging, at 20 cents per cubic yard	$6,000 00
2. 60 cubic yards of sunken ledge, broken up and removed, at $50 per cubic yard, measured *in situ*	3,000 00
Engineering expenses and other contingencies	1,302 28
Total	10,302 28
Amount available July 1, 1881	5,302 28
Amount (estimated) required to *complete* the projected improvement of channel	5,000 00

The works completed up to July 1, 1881, for the preservation and improvement of this harbor, consist of the following, to wit:

1. *Sea-walls* have been built for the protection of the headlands at Point Allerton, Great Brewster Island, Lovell's Island (north and southeast heads), Gallop's Island, Long Island (north head), Rainsford Island, and Deer Island (north, middle, and south heads), some of which are in good condition and others require repairs.

2. *Sunken rocks* have been broken up and removed, including Kelly's Rock, and all the known sunken ledges near it, Tower Rock, Corwin Rock, the ledges recently discovered at the west end of Great Brewster Spit, and between there and George's Island, all situated in the main ship-channel at "The Narrows," to a depth of 23 feet at mean low-water; also, to the same depth the sunken ledges and bowlders recently discovered in the main ship-channel at the Upper Middle; also, Barrel Rock, in Broad Sound, and State and Palmyra Rocks, situated about one-half a mile east of Castle Island.

3. *The main ship channel* has been straightened, widened, and deepened, so as to have a width of not less than 600 feet and a depth of not less than 23 feet at mean low-water at the west end of Great Brewster Spit, at the southeast and southwest points of Lovell's Island and Cape Cod Shoal, at the Upper Middle, and at Anchorage Shoal.

4. *Man-of-war Shoal*, in the Upper Harbor, at the confluence of Charles and Mystic rivers, has been entirely removed by dredging to a depth of 23 feet at mean low-water.

5. *The channel in Mystic River, near its mouth*, has been opened by

dredging to a depth of 23 feet at mean low-water for an average width of 250 feet.

6. *In Hingham Harbor* the channel has been opened by dredging and the excavation of sunken ledges for a width of 100 feet to a depth of 8 feet at mean low-water.

7. *Nash's Rock Shoal*, situated in the lower harbor of Boston, between Point Allerton and Great Brewster, has been removed by dredging and the excavation of sunken rocks to a depth of not less than 20½ feet at mean low-water, being an increase of about 7 feet in depth on its shoalest part.

The location of all the above-named *completed* works are shown on the sketch of Boston Harbor accompanying last annual report.

In the annual report for the fiscal year ending June 30, 1878, will be found a history of the works then completed, giving their commencement, progress, and completion, which it is not deemed necessary to repeat in this report.

The following is a recapitulation of the *additional* amounts required for the completion of the several works projected for the improvement of Boston Harbor, to wit:

1. Widening main ship-channel at Upper Middle at its western end, and for rebuilding and repairing sea-walls in Boston Harbor proper	$24,000
2. Completing improvement of Charles River	67,500
3. Completing channel leading to Nantasket Beach	5,000
Total	96,500

Which amount could be profitably expended during the fiscal year ending June 30, 1883.

The several works completed and now projected for the improvement of this harbor are in the port of Boston and in the collection district of Boston and Charlestown, Mass.

The following information in regard to the revenue and commerce of this port for the year ending December 31, 1880, has been furnished by the United States collector of customs, to wit:

Collected for revenue	$21,482,020 52
Value of domestic merchandise exported	66,393,615 00
Value of foreign merchandise exported (re-exports)	1,444,681 00
Value of foreign coin and bullion exported	31,923 00
Value of merchandise imported	68,649,083 00
Value of coin and bullion imported	128,301 00

	Number.	Tonnage.
American vessels arrived from foreign ports	515	225,348.00
Foreign vessels arrived from foreign ports	2,590	1,254,370.00
American vessels cleared for foreign ports	569	233,617.00
Foreign vessels cleared for foreign ports	2,569	1,198,031.00
Arrivals—coastwise	906	933,300.00
Clearances—coastwise	1,236	1,092,518.00
Vessels built within the district	15	5,018.51

The report of vessels in coasting trade only represents a portion of the vessels engaged in that trade, and only such as are required, for special reasons, to make a formal entry of same.

The following papers are hereto appended, viz:

Abstract of proposals received.
Abstract of contracts made.
A sketch of Boston Harbor, showing the locations of the several works of improvement completed to date, accompanied the last annual report.

Money statement.

July 1, 1880, amount available	$91,698 92	
Amount appropriated by act approved March 3, 1881	100,000 00	
		$191,698 92
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	57,014 03	
July 1, 1881, outstanding liabilities	4,447 67	
		61,461 70
July 1, 1881, amount available		130,237 22
Amount (estimated) required for completion of existing project		96,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		96,500 00

Abstract of proposals received August 17, 1880, for dredging in Boston Harbor, Massachusetts.

Number for reference.	Bidders.	Residence.	Dredging, measured in scows.		
			Anchorage Shoal, 50,000 cubic yards.	Mystic River Shoal, 50,000 cubic yards.	Charles River. 100,000 cubic yards.
			Per cu. yd.	*Per cu. yd.*	*Per cu. yd.*
1	Moore & Wright	Portland, Me	$0 39	$0 29	$0 39
2	New England Dredging Co	Boston, Mass	49	32	
3	Aug. B. Martin	Boston, Mass	60		45
4	Frank Pidgeon, jr	New York City	69	89	74
5	Jesse Boynton and Lyman Boynton.	Providence, R. I., Boston, Mass.	72	32	
6	Joseph E. Bartlett	Boston, Mass		32¼	
7	Isaac A. Sylvester	Newton, Mass			40

Abstract of proposals received December 6, 1880, for dredging and the removal of sunken ledges from the channel leading from Boston Harbor to Nantasket Beach, Massachusetts.

Number for reference.	Bidders.	Residence.	Dredging 15,000 cubic yards, more or less, measured in scows.	Removal of three sunken ledges, about 12 cubic yards, measured *in situ.*
			Per cu. yd.	
1	Robert Hamilton, jr	Chebeague Island, Me.	$0 18¾	No proposals received.
2	William Woolley	Boston, Mass	25	
3	William W. Wright	Geneva, N. Y	27	

Abstract of proposals received June 6, 1881, for dredging in Boston Harbor, Massachusetts.

Number for reference.	Bidders.	Residence.	Mystic River Shoal, 50,000 cubic yards.	Charles River, 100,000 cubic yards.	Remarks.
1	Eastern Dredging Company, by William W. Wright, president.	Portland, Me.	22 cents per cubic yard, measured in scows.	37 cents per cubic yard, measured *in situ.*	
2	New England Dredging Company, by Charles H. Souther, treasurer.	Boston, Mass.	35 cents per cubic yard, measured in scows.	35 cents per cubic yard, measured in scows.	
3	Augustus B. Martin	Boston, Mass.		35 cents per cubic yard, measured *in situ.* 37 cents per cubic yard, measured *in situ.*	Below Brookline Bridge. Above Brookline Bridge.

Abstract of contracts made during the fiscal year ending June 30, 1881, for the improvement of Boston Harbor, Massachusetts.

Date of contract.	Contractors.	Nature of work.	Price per cubic yard, measured in scows.
1880.			*Per. cu. yd.*
Aug. 27	Moore & Wright, Portland, Me.	Dredging at Anchorage Shoal, 65,000 cubic yards, more or less.	$0 39
Aug. 27	Moore & Wright, Portland, Me.	Dredging Mystic River Shoal, 50,000 cubic yards, more or less.	29
Aug. 27	Moore & Wright, Portland, Me.	Dredging Charles River from near its mouth in the harbor, upwards, 50,000 cubic yards, more or less.	39
Dec. 13	Robert Hamilton, jr., Chebeague Island, Me.	Dredging channel leading from Boston Harbor to Nantasket Beach, 15,000 cubic yards, more or less.	18¾
1881.			
June 14	Eastern Dredging Company, Portland, Me.	Dredging Mystic River Shoal, 80,000 cubic yards, more or less.	22
June 14	Eastern Dredging Company, Me.	Dredging Charles River from near its mouth to Brookline Bridge and thence to Market Street Bridge, 100,000 cubic yards, more or less.	*37

*Measured *in situ*.

A 19.

IMPROVEMENT OF SCITUATE HARBOR, MASSACHUSETTS.

A survey of this harbor was made in 1878, with a view to its adaptability as a *harbor of refuge*.

It is situated on the west shore of Massachusetts Bay, about midway between Boston and Gurnet light, and distant about 14 miles from each. It is also distant from Race Point about 25 miles, in a direction about N. 22° W.

The coast between Scituate and the entrance to Boston Harbor, is so densely studded with dangerous shoals and sunken rocks that no vessel could find shelter there at times, when most necessary—in fogs and easterly storms—so that if a vessel passing around Cape Cod, or coming elsewhere from the eastward, should fail to make Boston Harbor, and fall to the leeward, it could now find no other refuge except Plymouth Harbor (about 18 miles to the southward), the approach to which at the "Cow Yard" is difficult and dangerous, especially for strangers.

This harbor has no protection from easterly storms, and in its deepest part has not more than 3 to 5 feet of water at mean low-water (the mean rise and fall of the tides being 9¾ feet), and this for an area not exceeding 6 acres. It would therefore be necessary, in order to make it a harbor of refuge, to build for its protection, one breakwater or more at its entrance, and to excavate a basin of sufficient depth and area inside.

In the project submitted in the report on the survey, it was proposed, in order to have an easy and well-marked entrance into the harbor, to build two breakwaters, one to project from Cedar Point near the lighthouse on the north side of the entrance, in a direction S. 36° E. for a distance of 800 feet, and the other to project from the point of the first cliffs, on the south side of the entrance, in a direction N. 10° W. for a distance of 730 feet. By being so located, they shut out all easterly winds from the proposed harbor, and also occupy the shoalest and most favorable sites in regard to cost.

These works are designed to be built of rubble-stone, to a height of 4 feet above the plane of mean high-water, and with a width of 20 feet on top, of which the exterior slope is to be 1:2, and the interior slope 45°; and the channel extremities to be enlarged and raised to a height of 10 feet above mean high-water, so as to afford conspicuous guides for the entrance.

The accompanying sketch shows the improvements projected for this harbor.

The estimated cost of the two breakwaters, as revised, with the greatly increased prices now ruling for such work, is as follows, to-wit:

55,000 tons of rubble-stone placed in the breakwater, at $1.50 per ton of 2,240 pounds	$82,500
Engineering and other contingent expenses	7,500
Total for breakwaters	90,000

The estimated cost of the *dredging*, revised to correspond with modified project and increased prices now ruling for same, that would be required for a harbor of refuge only (1,450 feet in length and 750 feet in width) is as follows, to-wit:

1. Entrance, so as to have a depth of 15 feet at mean low-water up to the end of outer breakwater, and thence sloping from 15 to 12 feet to the end of the inner breakwater, 165,000 cubic yards of dredging, at 35 cents per cubic yard, measured *in situ*	$57,750
2. Inner harbor for a depth of 10 feet at mean low-water, and to be 12 feet in depth, for a width of 300 feet next to the inner breakwater, 335,000 cubic yards, at 35 cents per cubic yard, measured *in situ*	117,250
Engineering and other contingent expenses	15,000
Total for dredging for harbor of refuge	190,000
Total as above for *two breakwaters*	90,000
Total estimated cost for harbor of refuge	280,000

If in addition to the foregoing work projected for a harbor of refuge the deepening of the harbor above, as shown on the accompanying sketch, for the benefit of the local commerce of Scituate, should be favorably considered, the following is an estimate of its cost, viz:

Dredging of the upper portion near the wharves of Scituate to a depth of 3 feet, and thence increasing to a depth of 10 feet at mean low-water, 106,500 cubic yards, at 35 cents per cubic yard, measured *in situ*	$37,275
Engineering and other contingent expenses	2,725
Total additional cost for deepening the harbor up to the wharves	40,000

For the improvement of this harbor, the following appropriations have been made by Congress, viz:

By the river and harbor act of June 14, 1880	$7,500
By the river and harbor act of March 3, 1881	10,000
Total	17,500

Under these two appropriations a contract was made May 27, 1881, with Mr. Charles H. Edwards, of Quincy, Mass. (the only bidder), for 10,000 tons, more or less, of "granite quarry grout," at $1.56 per ton of 2,240 pounds, placed in the work, or for an inferior and smaller kind of rubble-stone, at $1.25 per ton; the same to be completed on or before the 30th of November next. Operations were commenced by the contractor in the latter part of June.

The following-named papers are hereto appended, viz:

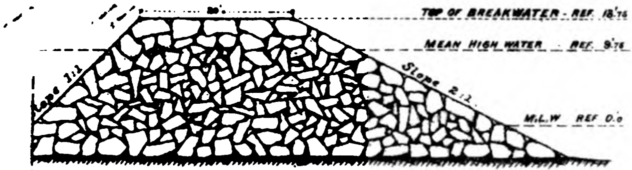
Abstract of proposals received.
Abstract of contracts made.
Sketch showing the projected improvements.

MAP OF
E HARBOR MASSACHUSETTS
SHOWING THE PLAN ADOPTED
MAKING IT A HARBOR OF REFUGE
Projected by
ENERAL GEO. THOM, COLONEL OF ENGINEERS.

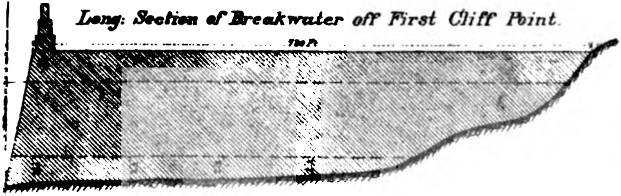
Scale of Feet.

re expressed in feet and tenths and are referred to the plane of mean low water
nd fall of tides is about 9½ feet
ted for deepening the harbor and the entrance thereto consists of excavating
ile shown on the drawing, - as follows:
tremity (a) of the northern breakwater, to a depth of 15 ft. at mean low water.
(b). southern " and (a) to a depth of 12-15 ft at m.l.w.
ern breakwater and line c-c' to a depth of 12 ft. at m.l.w.
c-c' and d-d' to a depth of 10 ft. at m.l.w.
d-d' and e-e' to a depth of 10-8 ft. at m.l.w.
e-e' and the wharf front, to a depth of 8 ft at mean low water.

Section on Line a - b.



Long: Section of Breakwater off First Cliff Point.



ections.

Section.)

Money statement.

July 1, 1880, amount available	$7,500 00	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$17,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		220 06
July 1, 1881, amount available		17,279 94
Amount (estimated) required for completion of existing project		262 500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		100,000 00

Abstract of proposals received May 25, 1881, *for furnishing rubble-stone for breakwater in Scituate Harbor, Massachusetts.*

Number for reference.	Bidders.	Residence.	About 18,000 tons granite quarry grout.	Small stones and bowlders in such proportion as may be accepted.
1	Charles H. Edwards	Quincy, Mass	$1.56 per ton of 2,240 pounds.	$1.25 per ton of 2,240 pounds.

Abstract of contracts made during the fiscal year ending June 30, 1881, *for the improvement of Scituate Harbor, Massachusetts.*

Date of contract.	Contractor.	Nature of work.	Price per ton of 2,240 pounds.
1881. May 27	Charles H. Edwards, Quincy, Mass	Furnish and place 10,000 tons, more or less, "granite quarry grout" in the proposed breakwater.	$1 56
		Or suitable bowlders of smaller dimensions than required for the "granite quarry grout" to be deposited in the core of the work, in such quantity as shall be accepted.	1 25

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., March 29, 1881.

SIR: I have the honor to submit the inclosed project of Col. Geo. Thom, Corps of Engineers, for the application of the funds available for improving Scituate Harbor, Massachusetts, derived from the appropriations made by the river and harbor act of June 14, 1880, and March 3, 1881, amounting respectively to $7,500 and $10,000, aggregating $17,500.

The question of improving this harbor was referred to the Board of Engineers for Fortifications and for River and Harbor Improvements, in September last, and its report, together with Colonel Thom's project, was submitted to the Secretary of War, December 7, 1880, and by him sent to the House of Representatives for the information of the Committee on Commerce, December 11, 1880.

In submitting the report I concurred in the views of the Board, with suggestion that the plan of improvement, as well as the order of the construction proposed by it, be adopted. But the appropriation then available ($7,500) being so disproportionate to the estimated cost of the whole work ($235,000), it was suggested that its commencement be deferred for the present to await the future actionof Congress.

Congress having made an additional appropriation of $10,000, as above stated, it may be considered obligatory upon the War Department to enter now upon the work; and I have, accordingly, to recommend that it be undertaken in accordance with the project of Colonel Thom, based upon the recommendation of the Board of Engineers.

Previous papers herewith.

Very respectfully, your obedient servent,

H. G. WRIGHT,
Chief of Engineers, Brig. and Bvt. Maj. Gen.

Hon. ROBERT T. LINCOLN,
Secretary of War.

[1st indorsement.]

The recommendation of the Chief of Engineers is approved.

By order of the Secretary of War.

H. T. CROSBY,
Chief Clerk.

WAR DEPARTMENT, APRIL 1, 1881.

REPORT OF THE BOARD OF ENGINEERS.

OFFICE OF BOARD OF ENGINEERS FOR FORTIFICATIONS
AND FOR RIVER AND HARBOR IMPROVEMENTS, &C.,
New York, September 13, 1880.

GENERAL: The Board to whom was referred by your letter of July 6, 1880, the subject of improving Scituate Harbor, has the honor to submit its views thereon as follows:

This harbor, on the west shore of Massachusetts Bay, about midway between Boston light and Plymouth, were it made accessible at all stages of the tide, and suitably protected by breakwaters, would be much resorted to by small and medium class vessels navigating the bay, as well as by those of a larger class from without, driven to its vicinity by the severe northeast gales of winter. The many wrecks upon this reach of coast during the past years attest the risk incurred by the commerce that centers in Boston, and doubtless is the cause that aid has been more than once sought for its further protection. Since the establishment of a first-class light on Minot's Ledge the danger to shipping entering the bay has been somewhat lessened, but the light is not always visible, by reason of the dense snow-storms of this latitude, nor can it be of much help to vessels more or less disabled, nor to those powerless to resist *very severe* gales. An attainable harbor of refuge is their only safety.

As early as 1853, by resolution of the Congress of the United States, Scituate Harbor, together with North River, adjacent, was surveyed under the direction of Bvt. Maj. J. G. Barnard, Corps of Engineers. In his report, November 16, 1853, he alludes to this harbor as "near the great track of the immense commerce of Boston, and upon which great losses of life and property occur," and adds:

> It is believed by many that with such improvements as could be given it by art, it may be made the means of affording a safe refuge to all vessels requiring it.

Further, as a means of accomplishing the end proposed, he suggests dredging the harbor, and building for its protection a breakwater in a southeast direction from the shore, at Light-House Point.

Nothing, however, was done at that time beyond the survey and report; but after many years this subject has been brought up anew, and memorials forwarded to Congress asking for the improvement of Scituate Harbor. In accordance therewith, the river and harbor act approved June 18, 1878, called for its survey, "with a view to its adaptability as a harbor of refuge." This survey was made under the direction of Gen. George Thom, Corps of Engineers, and following his report thereon, with chart showing his plan of improvement, Congress appropriated $7,500 for its commencement.

Accompanying General Thom's report is a letter of the Hon. George Lunt, setting forth quite fully and cogently the question at issue. He has for several years been a resident of Scituate, and has evinced on all suitable occasions his interest in the improvement of its harbor as a measure for the general benefit of commerce, giving much time and effort to its furtherance.

Also a report of a committee of the Boston Board of Trade, the greater portion of which we quote as follows:

> The situation of the harbor, its proximity to Minot's light, its size, and the readiness with which it could be entered during dangerous on-shore winds, were there the necessary depth of water, are doubtless sufficiently well known to the Board to need no further notice. It is equally well known that there are few days in the year, however boisterous the weather, when there are not many vessels, coasters, fishermen, and others, bound in and out of Boston Bay. With strong winds from northward and the northeastern quarters, vessels making for this port often fall to leeward of the harbor, and there is then nothing for them but to drift helplessly and hopelessly into the bay. There is no harbor open to them, the entrance to Plymouth Roadstead, known as the Cow Yard, being so narrow and difficult of approach for a stranger as to render it almost wholly useless. During the winter, and in fact for about eight months of the year, the winds referred to are accompanied by thick weather, rain, sleet, or snow, sometimes by all together, and oftentimes by intense cold, rendering it at such times very difficult, if not impossible, to work or manage a vessel, so that, failing to reach Boston Harbor, she is virtually at the mercy of the elements and in a situation of the utmost peril.
>
> Your committee therefore recommend that the bar and harbor of Scituate be dredged to a depth of 15 feet at low-water, so as to render it available as a harbor of refuge at all times for vessels of small and medium size. They recommend that a breakwater from the northern point of the harbor be thrown out in such direction and to such extent as the engineers employed may think proper, to break the force of heavy seas from the northeastern quarter and give smooth riding to vessels seeking shelter, as well as to prevent the sand from again setting up the bar, to the detriment of the harbor; that a light-house be properly placed and lighted as a guide to the entrance at night, and that a steam-whistle be likewise placed upon, or an automatic buoy at proper distance outside the breakwater, as a guide when approaching in thick weather.
>
> They believe such improvement of this harbor would unquestionably be in the interests of economy, as in a few years the amount of property saved thereby would far exceed the needed outlay, with the cost of keeping all in proper condition; and in the interests of humanity its value could be scarcely overestimated or overstated.
>
> They, therefore, ask that your Board earnestly and forcibly press upon Congress and the proper branch or branches of the Federal Government the importance of this scheme, inviting, if it be thought expedient, the Harbor Commission and such other local influences as may have weight and value, to co-operate with and support them in their efforts.

* * * * * * *

The foregoing is a brief statement of the efforts that have been hitherto made to obtain the aid of the government in the improvement of Scituate Harbor, and of its bearing upon the general commerce of the country.

The project of General Thom for effecting the above purpose is described in his report (Report of the Chief of Engineers, 1879, vol. 1, page 284), and delineated upon chart accompanying that report.

It contemplates dredging a portion of the harbor, and its entrance, to a depth of 10 feet at mean low-water, and securing this anchorage against the ocean waves by the construction of two breakwaters, the outer to extend 800 feet in a southeasterly direction from the old light-house; the inner northerly 730 feet from a designated point on the shore of the first cliff.

The amount of excavation is thought to be the minimum that will provide a sufficient anchoring ground, for the present needs of commerce, and it seems quite probable that the harbor so created will be fully occupied during the prevalence of winter gales.

The Board has considered the question of a single breakwater from Light-House Point, extending farther southward, in connection with dredging the central and northern portion of the harbor, as a modification of the plan proposed, with a view to greater freedom of ingress and egress, and to economy of construction; but on examination it appears that there will be little, if any, economy in the change, while the protection afforded might be less efficient, as the opening of the harbor is exposed to the great ocean swell from northeast to southeast.

Though the storm-wave will break on the south side of the entrance, the effect of the ground-swell, to some extent, will be felt within; not disastrously, but sufficiently to create disturbance among closely crowded vessels, with barely enough water under their keels to prevent grounding at extreme low-tide. We therefore adopt General Thom's project for improving Scituate Harbor, without change, further than these suggestions:

1st. That in the progress of the work the two breakwaters be not built to the full lengths indicated on the chart, until experience shows the necessity therefor.

2d. That a space immediately behind the inner breakwater—say 300 feet wide—be excavated to a depth of 12 feet, instead of 10, as proposed.

3d. That the channel from the north end of the inner breakwater be made 12 feet deep, and sloping thence to 15 feet at the south end of the outer—all the dredging exterior thereto being carried to a depth of 15 feet, so that vessels entering at low-tide on a heavy sea may avoid the risk of striking.

Facility of ingress and egress may require a wider channel of entrance, but that question can only be decided by the test of experience, and it is quite probable that the future demands of commerce may require a larger and deeper anchoring ground than the project now presented makes provision for.

The increased depth of the excavation suggested by the Board will increase General Thom's estimate from $175,000 to $200,000. General Thom, when before the Board to explain his project, expressed his opinion that the price (20 cents per cubic yard) in his estimate for excavation was too small, and in this opinion the Board concur.

Respectfully submitted.

Z. B. TOWER,
Colonel of Engineers, Bvt. Maj. Gen.
JOHN NEWTON,
Colonel of Engineers, Bvt. Maj. Gen.

The CHIEF OF ENGINEERS, *U. S. A.*

A 20.

IMPROVEMENT OF PLYMOUTH HARBOR, MASSACHUSETTS.

The existence of this harbor depends entirely upon the protection and preservation of Long Beach, which is a narrow strip of land that extends 2¾ miles out from the mainland, in a northwesterly direction, nearly parallel to the shore of the town of Plymouth, and distant from it about 1 mile. It affords to the harbor its only shelter from easterly storms.

In late years it has been washed away in some places, and much weakened in others, to an extent seriously threatening the ruin of the harbor.

For the protection and preservation of this beach various works have been built, from time to time, until they have finally proved to be efficient and successful.

These works consist of bulkheads, jetties, and groins built for the accumulation of sand, and the planting of beach grass, also to accumulate sand and give permanency to the beach thus formed; whereby a ridge has been formed throughout the whole extent of the beach, which is, for the most part, covered with beach grass, and is now in an efficient condition.

A history and description of the several works built on Long Beach will be found in the annual report for the fiscal year ending June 30, 1877.

The following sums have been appropriated by Congress, and allotted for the preservation and improvement of this harbor, from 1864 up to and including March 3, 1881, viz:

Amount allotted in 1866 from appropriations made July 2, 1864, for harbors on the Atlantic coast	$8,300
Amount allotted under act of July 25, 1868	7,500
By river and harbor act of July 11, 1870	10,000
By river and harbor act of March 3, 1871	10,000
By river and harbor act of June 10, 1872	2,500
By river and harbor act of March 3, 1873	3,000
By river and harbor act of June 23, 1874	5,000
By river and harbor act of March 3, 1875	10,000
By river and harbor act of June 18, 1878	5,000
By river and harbor act of March 3, 1879	3.500
By river and harbor act of June 14, 1880	10,000
By river and harbor act of March 3, 1881	10,000
Total	84,800

Under the appropriation of $10,000, made by the act of March 3, 1875, for the improvement of this harbor, a channel was opened by dredging from the "Middle Ground," up to Long Wharf, a distance of about 2,500 feet, for a width of 50 feet, and to a depth of 6 feet at mean low-water, or 16 feet at mean high-water. The project for the improvement of this harbor provides for a channel 100 feet in width, up to Long Wharf, to be extended southward to the mouth of Town Brook, a distance of about 900 feet above Long Wharf, so as to form a basin in front of the wharves of the city, 150 feet in width, with a depth of 8 feet at mean low-water.

Under the appropriation of $10,000 made by the river and harbor act of June 14, 1880, for this harbor, a contract was made August 24, 1880, with Messrs. Robert Hamilton, jr., of Chebeague Island, and Solomon Sawyer, of Yarmouth, Me., the lowest of four bidders, for 60,000 cubic yards, more or less, of dredging, at 17 cents per cubic yard, measured *in scows*.

Under this contract 43,950 cubic yards of dredging has been done up to the end of the fiscal year, whereby the *main channel* has been completed to its full projected width (viz, 100 feet), and to a depth of 6 feet at mean low-water, or 16 feet at mean high-water, from deep water near the Middle Ground up to the wharves of Plymouth; and a portion of the projected basin in front of the wharves has been dredged to a depth of 8 feet at mean low-water.

The remainder of the dredging under this contract is to be applied to deepening the basin.

Under the appropriation of $10,000 made by the river and harbor act of March 3, 1881, for this harbor, a contract was made June 14, 1881, with the Eastern Dredging Company, of Portland, Me., the only bidder, for 40,000 cubic yards, more or less, of dredging, at 23 cents per cubic yard, measured *in scows*, the same to be completed on or before January 31, 1882. This dredging is to be applied to the *completion* of the projected basin.

All the works projected for the protection and preservation of Long Beach (which gives to this harbor its only shelter from easterly storms) were completed in 1879; but, exposed as they are to injury from those violent storms, they will necessarily require occasional repairs.

For this purpose an appropriation of $1,000 is asked.

Plymouth Harbor is in the collection district of Plymouth, of which Plymouth is the port of entry.

The nearest light-houses are the Gurnet lights, about 5 miles distant from the city of Plymouth.

The following information in regard to the revenue and commerce of the port of Plymouth for the year ending December 31, 1880, has been furnished by the United States collector of customs of that port:

REVENUE.

Collections for 1880	$28,208 66
Expenses collecting revenue	2,574 62
Net amount paid the government	25,634 04

FOREIGN IMPORTS.

Hemp	tons..	1,162
Burlaps	yards..	119,197
Coal	tons..	729
Potatoes	bushels..	1,094

Value, $132,660.

FOREIGN EXPORTS.

Cordage	coils..	956
Swedes jack-plates		6,600

Value, $5,768.

REMAINING IN BOND.

Hemp	tons..	664
Burlaps	yards..	63,623

Value, $108,618.

DOMESTIC IMPORTS.

	Cargoes.	Tons.	
Cotton	3	125	
Coal	60	16,400	
Iron	37	3,800	
Fish, dry	4	200	= 2,000 quintals.
Fish, pickled	8	600	= 6,000 quintals
Salt	6	270	
Granite	2	200	
Lumber	16	1,800	= 2,000,000 feet
Tar	2	370	= 2,500 tierces.
Hay	11	758	
	149	24,523	

Miscellaneous, by packets and steamers, estimated at 15,000 tons.

Estimated value, $1,044,000.

1
16
20
19
14
21
12
9
10½
4½
15½
7½
MEAN HIGH WATER
MEAN LOW WATER
5
11

DOMESTIC EXPORTS.

	Cargoes.	
Fish, dry	6	6,000 quintals.
Nails	10	800 tons.
Barrels, empty	12	6,000
Wood	10	400 cords.
Value, $99,400.	38	

There are some twenty to twenty-five sail of vessels that are not included, engaged in the mackerel, lobster, and fisheries. There are also, not included, the regular steamers and packets plying between this port and other domestic ports, or excursion steamers. Most of the vessels arriving with cargoes, sail from here light.

There were no vessels built in this district in 1880.

The following-named papers are hereto appended, to-wit:

Two abstracts of proposals received.

Abstracts of contracts made.

Sketch of Plymouth Harbor, showing all the improvements made and projected.

Money statement.

July 1, 1880, amount available	$13,528 85	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$23,528 85
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	7,114 83	
July 1, 1881, outstanding liabilities	1,494 32	
		8,609 15
July 1, 1881, amount available		14,919 70
Amount (estimated) required for completion of existing project		1,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		1,000 00

Abstract of proposals received August 17, 1880, for dredging Plymouth Harbor, Massachusetts.

Number for reference.	Bidders.	Residence.	Dredging 40,000 cubic yards, more or less.
1	Robert Hamilton, jr., and Solomon Sawyer	Chebeague Island, Me. Yarmouth, Me.	17 cents per cubic yard, measured in scows.
2	William W. Wright*	Geneva, N. Y	*26 cents per cubic yard, measured in scows.
3	Edgar M. Payn	Albany, N. Y	33 cents per cubic yard, measured in scows.
4	Augustus B. Martin	Boston, Mass	50 cents per cubic yard, measured in scows.

*If time of completion be extended to June 30, 1881, bids 20 cents.

Abstract of proposals received June 6, 1881, for dredging in Plymouth Harbor, Massachusetts.

Number for reference.	Bidders.	Residence.	Dredging 45,000 cubic yards, more or less.
1	Eastern Dredging Company, by William W. Wright, president.	Portland, Me	23 cents per cubic yard, measured in scows.

Abstract of contracts made during the fiscal year ending June 30, 1881, for the improvement of Plymouth Harbor, Massachusetts.

Date of contract.	Contractors.	Nature of work.	Price per cubic yard.
1880.			
Aug. 24	Robert Hamilton, jr., of Chebeague Island, Me., and Solomon Sawyer, of Yarmouth, Me.	Dredging from the Middle Ground up to Long Wharf and above, 60,000 cubic yards, more or less.	$0 17
1881.			
June 14	Eastern Dredging Company, by William W. Wright, president.	Dredging, in completion of the "Inner Basin," near Long Wharf and above, 40,000 yards, more or less.	23

A 21.

IMPROVEMENT OF PROVINCETOWN HARBOR, MASSACHUSETTS.

Since the resumption of work in 1866, for the improvement of rivers and harbors, the aggregate sum appropriated by Congress and allotted to this harbor amounts to $106,568.44.

All the works projected for the improvement of this harbor have been completed as specified in the Annual Report of 1879, with the exception of the stone bulkhead on the eastern end of Long Point. These works are all in good condition and have fully answered the purpose for which they were designed. They will, however, require constant watching and repairs, liable as they are to injury by the violent storms to which they are exposed; for which purpose an appropriation of $1,000 is recommended for the fiscal year ending June 30, 1883.

Owing to the destructive effects of the storms on the beach of Long Point, as well as on the wooden bulkhead built for its protection and preservation, it has become necessary to extend the stone bulkhead farther along the beach to the westward, and to complete it to the extent now projected will require—

About 5,000 tons of rubble-stone, the estimated cost of which, placed in the work, is	$8,000
Adding for superintendence and other contingencies	1,000
And for annual repairs of other works as above	1,000
Total amount required	10,000
Amount appropriated by the river and harbor act of March 3, 1881	5,000
Additional amount required to complete the projected improvements	5,000

Under the appropriation of $500 made by the river and harbor act of June 14, 1880, together with the unexpended balance of the appropriation of March 3, 1879, aggregating $1,112.17, repairs have been made where most necessary on the bulkhead on Long Point, in which $664\frac{800}{2240}$ tons of rubble-stone was used.

Under the appropriation of $5,000 appropriated for this harbor by the river and harbor act of March 3, 1881, proposals have been invited for 3,500 tons of rubble-stone for continuing work on the Long Point bulkhead, in response to which six bids were received which were all rejected as being too high (see abstract of proposals herewith). Proposals are to be again invited for the stone as soon as practicable.

Provincetown, in which the several works above referred to are situated, is a port of entry in the collection district of Barnstable, Mass.

The following information in regard to the revenue and commerce of that port for the year ending December 31, 1880, has been furnished by the deputy collector of customs, to-wit:

Amount of revenue collected	$1,671 69
Value of imports	$53,323 83
Number of arrivals and departures of vessels	5,680

He estimates, from the best data available, the amount of commerce and navigation that will be benefited by the proposed improvements in Provincetown Harbor to be worth $20,000,000.

The following papers are hereto appended, to-wit:

Two abstracts of proposals received.
Abstract of contracts made.

Money statement.

July 1, 1880, amount available	$1,112 77	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$6,112 77
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		1,125 68
July 1, 1881, amount available		4,987 09
Amount (estimated) required for completion of existing project		5,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		5,000 00

Abstract of proposals received August 17, 1880, for furnishing rubble-stone for the bulkhead on Long Point, Provincetown Harbor, Massachusetts.

Number for reference.	Bidders.	Residence.	About 750 tons rubble-stone.	
			500 tons large quarry grout.	250 tons small rounded bowlders.
1	Joseph H. White	Hyde Park, Mass	$1.24 per ton of 2,240 pounds.	$1.39 per ton of 2,240 pounds.
2	Cummings H. Holden	Tremont, Me	$2.50 per ton of 2,240 pounds.	$1.50 per ton of 2,240 pounds.

Abstract of proposals received June 6, 1881, for furnishing rubble-stone for the bulkhead on Long Point, Provincetown Harbor, Massachusetts.

Number for reference.	Bidders.	Residence.	About 3,500 tons rubble-stone.	
			2,500 tons granite quarry grout.	1,000 tons small rounded bowlders.
1	Charles H. Edwards	Quincy, Mass	$1.60 per ton of 2,240 pounds.	$1.70 per ton of 2,240 pounds.
2	Isaac Hamilton	Portland, Me	$1.67 per ton of 2,240 pounds.	
3	Joseph H. White	Hyde Park, Mass	$1.71 per ton of 2,240 pounds.	$1.93 per ton of 2,240 pounds.
4	Isaac A. Sylvester	Newton, Mass	$1.74 per ton of 2,240 pounds.	$1.99 per ton of 2,240 pounds.
5	C. T. Derry & Co	Boston, Mass	$1.79 per ton of 2,240 pounds.	$2.04 per ton of 2,240 pounds.
6	James Ginn	Bath, Me	$2.10 per ton of 2,240 pounds.	$1.90 per ton of 2,240 pounds.

Abstract of contracts made during the fiscal year ending June 30, 1881, for the improvement of Provincetown Harbor, Massachusetts.

Date of contracts.	Contractors.	Nature of work.	Price per ton of 2,240 pounds.
1880. August 21.	Joseph H. White, Hyde Park, Mass.	Furnishing and delivering rubble-stone for projected stone bulkhead on Long Point.	
		"Large quarry grout," 500 tons, more or less	$1.24
		"Small rounded bowlders," 250 tons, more or less	$1.39

A 22.

SURVEY OF MALDEN RIVER, MASSACHUSETTS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., December 1, 1880.

GENERAL: I have the honor to submit the following report on the survey of Malden River, Massachusetts, made under my direction, in September last, by Mr. Sophus Haagensen, assistant engineer, with a view to its improvement, as called for by act of Congress approved June 14, 1880, "making appropriations for the construction, repair, preservation, and completion of certain public works on rivers and harbors, and for other purposes," the same being accompanied by a map of the survey, showing the proposed improvements.

This river is a tributary to Mystic River into which it empties about 3 miles above its mouth at the navy-yard in Boston Harbor. In its present condition it is navigable from the bridge at the rubber works to its junction with the Mystic, a distance of about 2 miles, with a depth of barely 7 feet at high-water. This river was very tortuous previous to 1847-'48 (as shown by the drawing), when it was straightened and otherwise improved by parties interested in its navigation, for an extent of about three-fifths of a mile below the bridge at the rubber works. It is now desired to have the channel straightened below and so improved throughout that vessels drawing 10 feet of water can ascend to that bridge on the high-water of neap-tides, the average rise of which above the plane of mean low-water is 8.4 feet, whilst the mean rise and fall of all the tides is 9.8.

For this improvement several channels have been projected for a width of 100 feet and a depth of 12 feet at mean high-water, with estimates for the excavation of same (measured *in situ*) as follows, to wit:

	Cub. Yards.
1. By a cut-off eastward of island near junction with Mystic River to a depth of 12 feet at mean high-water, together with a cut-off of same depth through the marsh about one-half a mile above and elsewhere where shaded in red on the drawing	153,600
2. By following the natural crooked bed of the river (as shown by the broken lines on the drawings) with a depth of 12 feet at mean high-water	96,500
3. By following the natural bed of the river from its junction with Mystic River up to the head of the first island, and thence through the marsh and elsewhere were shaded in red on the drawing	145,000
4. By adopting the first location above described with a depth of 13½ feet (instead of 12) at mean high-water in the cut-off east of the lower island	166,300

Of the four projects described above, it is recommended that, although the third one would in a great measure answer the purpose in view, the first one would for a small increase of cost make the best channel of which the river is capable. In which case the material excavated in the lower cut-off could be used for closing the present channel to the westward of it.

The estimated cost of this channel is as follows, to wit:

153,600 cubic yards of excavation (marsh loam, sand, &c.), at 20 cents per cubic yard measured *in situ*	$30,720
$4\frac{1}{10}$ acres of marsh land in upper cut-off, at $100	410
Adding for engineering and other contingencies, say	3,870
Total	35,000

The accompanying report and map of Mr. Haagensen describes the method and results of the survey made by him, to which attention is asked for more detailed information on the subject.

The accompanying letter of Mr. A. F. Sargent, town treasurer, furnishes all the information in my possession relative to the commerce and business interests that would be benefited by the proposed improvement of Malden River.

Respectfully submitted.

GEO. THOM,
Colonel of Engineers,
Brt. Brig. Gen., U. S. A.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. SOPHUS HAAGENSEN, ASSISTANT ENGINEER.

BOSTON, MASS., *October* 14, 1880.

GENERAL: I have the honor to submit the following report upon the survey of Malden River, Massachusetts, made in September, 1880, in pursuance of your instructions; also, to submit a map of the survey, drawn to a scale of $\frac{1}{2000}$, showing the proposed improvements.

The map embraces the river from the bridge at the rubber works, in Malden, to the junction of Malden River Channel with that of Mystic River, a length of 2 miles.

All the stations shown on the map were located by triangulation, a base, 6,392 feet long, having been measured on the Boston and Maine Railroad track.

The soundings on the lines 1–73, inclusive, were taken along a measuring line at each 10-foot mark, check on the stretch of the line being had in the known position of the stakes. On lines 74–86, inclusive, the soundings were located by intersecting ranges. For the sake of plainness of the chart only about one-third of the soundings have been entered thereon. The soundings are expressed in feet and tenths, and refer to the plane of mean low-water in Boston Harbor. By comparison of the two tide-staves established (8,800 feet apart) it was found that between them there was a slope of $1\frac{1}{4}$ feet on the river at low-water; the soundings have therefore been taken only at and near high-water, and referred to the plane of mean low-water, which is 5.4 feet on the normal staff in the Charlestown navy-yard. The soundings on the chart are thus, properly speaking, high-water soundings minus a constant 9.8 feet, the mean rise and fall of tide at the navy-yard. The benches are described in the notes. The natural banks of the river are high salt marsh, the average level of which is 10 feet above mean low-water. Borings show about 10 feet marsh loam, then a mixture of sand and clay, into which a rod could be pushed 3 to 4 feet without striking. The bed of the channel is soft mud, from 3 to 7 feet in depth; then follows hard-pan. Only at Station ⊙ XII (near line 17) was the bottom found hard and gravelly on the surface.

On account of the harder substratum found throughout the river it is thought that a channel excavated would be practically permanent. The present channel north of line 15 is in fact artificial, and has stood with little change since dredged in 1847–'48 by Mr. Otis Tufts.

The proposed improvements are to straighten and deepen the present channel.

The proposed channel has been drawn in parallel red lines and shaded in red; the width is 100 feet, and the depth on the upper part is 12 feet at mean high-water (2.2 feet at mean low-water); as the average neap high-waters rise 8.4 feet above the plane of reference, there would consequently be 10.6 feet in the channel on a neap high-water, and the new channel therefore be practicable for vessels drawing 10 feet up to the bridge at the rubber works.

In its present condition the channel above the Malden draw is barely practicable for vessels drawing 7 feet, below it for 8 feet, under the above suppositions.

From line 22 to 40, the present channel would be abandoned and a cut-off through the marsh substituted; as the bottom of the cut-off would be more than 1 foot below the old channel, the current would naturally follow the cut-off. Below line 52 it would be necessary to dredge 1½ feet deeper than above (or to give a depth of 13½ feet at mean high-water, 3.7 feet at mean low-water), in order to induce the current to pass east of the island instead of, as at present, to pass west of the same.

Estimates have been made for the excavation of the above-described channel as well as for one following the natural course of the river (shown in broken red lines), and for combinations of both, with various channel depths; for details of these estimates I would respectfully refer you to my letter of 23d ultimo. As one of the main objects of the improvement contemplated, viz, straightening of the channel, would not be accomplished by the alternatives referred to, the estimates for the straight channel are only here presented.

Although part of the dredging would be "tide-work," I have estimated the cost per cubic yard (*in situ*) at 17 cents, as the dredged material can be disposed of either by sales to parties along the river or by dumping in old channels, without necessitating the expensive tow through four draw-bridges to the dumping ground in the outer harbor.

The estimated cost is as follows:

1. For dredging a channel 2,250 feet in length, 100 feet wide, and 13½ feet deep at mean high-water (3.7 feet at mean low-water), thence additional 7,000 feet of the same width, and a depth of 12 feet at mean high-water (2.2 feet at mean low-water), requiring the excavation of 166,300 cubic yards (*in situ*) of mud and sand, at 17 cents per cubic yard	$28,271
2. For 4.1 acres of marsh land, at $100 per acre	410
3. Engineering and contingencies, about 10 per cent	2,819
Total cost of improvement	31,500

Very respectfully, your obedient servant,

SOPHUS HAAGENSEN,
Assistant Engineer.

Bvt. Brig. Gen. GEO. THOM,
Colonel of Engineers, U. S. A.

COMMERCIAL STATISTICS.

MALDEN, *December*, 1880.

DEAR SIR: Your note of the 29th ultimo was duly received, in which you express a desire for information relative to the business of Malden River.

* * * * * * *

The information furnished me as to the commerce of the river is as follows, viz:

	Tons.
Coal, for manufacturing use	15,000
Coal, for domestic use	35,000
Oats and corn, 20,000 bushels	400
Flour, 20,000 barrels	2,000
300,000 last blocks	1,750
Flint stone	1,000
500 casks lime and cement	375

Ten thousand cords wood, 5,000 cords bark, 2,000 tons hay, requiring 448 vessels, of 250 tons burden, being the largest vessel that can navigate the river. The charge for towing is $50 per vessel.

The United States Government owns property on the river to the value of $3,000,000.

One new factory, doing an extensive business, has been erected on the stream above the draw-bridge the past season, and others are in contemplation. The improvement of the river would greatly facilitate our present business, give prominence to the desirable sites along the river, and influence all the material interests of the town.

The number of inhabitants of Malden is upwards of 12,000, and application has been made to the general court for a city charter.

The expense attending the carrying out of the proposed improvement of the river cannot be large, and as the citizens generally are very anxious in regard to the matter, believing the business interest of the town depends largely upon its accomplishment, I hope and trust that the petition will receive a favorable consideration.

Yours, respectfully,

A. F. SARGENT,
Town Treasurer.

General THOM.

A 23.

SURVEY OF THE MOUTH OF NARRAGUAGUS RIVER, AT MILLBRIDGE, MAINE.

UNITED STATES ENGINEER OFFICE,
Portland, Me., December 2, 1880.

GENERAL: I have the honor to submit the following report on the survey of the mouth of "Narraguagus River, at Millbridge, Maine," made under my direction, in September and October last, by Mr. A. C. Both, assistant engineer, with a view to the improvement of its navigation, in compliance with the act of Congress approved June 14, 1880, "making appropriations for the construction, repair, and preservation of certain works on rivers and harbors, and for other purposes," the same being accompanied by a map showing the results of the survey, and a project for the improvement proposed.

This map shows, on a scale of $\frac{1}{5000}$, the present condition of this river from the bridge at Millbridge down to its mouth, below Turner's Point (a distance of about 3½ miles), with the depth of water at mean low-water, the mean rise and fall of the tides being 11.2 feet.

Under appropriations made in 1871 and 1872, the navigation of this river was very much improved from the bridge at Millbridge up to the head of navigation at Cherryfield—a distance of about 7 miles—by which coasting vessels of light draught with center-boards were enabled, for the first time, to run to and from Cherryfield at high-tide without transshipment in scows (before necessary) at Millbridge. But little, however, was done for improving the river below the bridge. At Millbridge the only obstruction to navigation which now requires special attention is the bar which extends from the "deep hole" (1½ miles below the bridge) down to deep water, on the shoalest part of which the channel has only about 5½ feet of water at mean low-water, or 4 feet at extreme low-water; whilst above the "deep hole" (which has a depth of about 10 feet at mean low-water) up to the bridge, the channel, though narrow and tortuous, has a depth of not less than 6½ feet at mean low-water.

To enable coasters to reach this "Deep Hole" (the only anchorage at low-water) in all stages of the tide, as well as to enable the coastwise steamers which touch at Millbridge to reach the lower landing (which is one of the principal landings for passengers and freight for this and the other neighboring towns on this part of the coast), it is proposed to open this channel where shown on the accompanying map by the area shaded in red, so as to have a width of not less than 200 feet at mean low-water, with a depth of not less than 11 feet up to Long Point, and thence to "Deep Hole" a depth of 9 feet at mean low-water—those depths being $1\frac{3}{10}$ feet less at extreme low-water.

The estimated cost of this improvement is as follows, viz:

229,092 cubic yards of dredging (*in situ*), at 20 cents	$15,818
Engineering and other contingent expenses, say	4,182
Total	20,000

For a more detailed description of this channel, as well as of the method and results of the survey, attention is asked to the accompanying report and map of the assistant engineer, Mr. A. C. Both, by whom the survey was made.

Respectfully submitted.

GEORGE THOM,
Colonel of Engineers,
Brt. Brig. Gen., U. S. A.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. A. C. BOTH, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Portland, Me., December 1, 1880.

GENERAL: I have the honor to submit the following report on a survey of the mouth of Narraguagus River, Millbridge, Me., made in pursuance of verbal instructions received from you in this office; also a copy of a rough plot of this survey, made in the field to a scale of $\frac{1}{5000}$.

TOPOGRAPHY.

The field work was commenced September 20 and completed October 16, 1880. A base line of 2,391.87 feet in length was measured across the flats on the east side of the harbor, from △ station C (at Fish Point) to △ station E. The extremities of this line are marked by holes, five-eighths inch diameter and 1 inch deep, drilled into the solid rock. The magnetic bearing of this line is 54° east of south.

The triangulation stations marked on the accompanying sheets N, M, L, K, A, B, C, D, E, F, G, H, and I, on the east shore, also the triangulation stations XII, XI, X_1, X, IX, VIII, VII, III, II, I, 0, 922, and SE., on the west shore, are permanently marked by holes drilled in the solid rock. The △ stations V, VII are marked by drill holes in large bowlders not likely to be moved, and the remaining △ stations, XII_1, XIII, XIV, and XV, are marked by copper nails driven into stakes or wharf timbers.

HYDROGRAPHY.

All the soundings, 3,826 in number, were taken on ranges established on shore, and were located by transit angles from suitable stations. They are referred to the plane of mean low-water, as determined by continuous tide observations, taken day and night for one lunation. The tide gauge used for these observations was nailed to the north corner of the upper steamboat wharf. The results obtained were as follows, viz:

TIDES.

	Feet.
Mean rise and fall of tides from continuous observations during one lunation ..	11.2
Highest observed high-water above mean low-water	12.9
Lowest observed low-water below mean low-water	1.3
Extreme observed rise and fall of tides	14.2
Lowest observed high-water above mean low-water	9.2
Highest observed low-water above mean low-water	2.3
Smallest observed rise and fall of tides	6.9
Difference between highest and lowest observed rise and fall of tides	6.0

BENCH-MARK.

The △ station XI, situated near the high-water line, about 150 feet south of the junction of upper steamboat wharf with the shore, was selected for a bench-mark. The mean low-water plane, established as above, was transferred to this bench by level, and was found to be 14.3 feet above this plane.

BORINGS.

The character of the material along the existing channel was determined by nine borings; the locations of these borings are indicated by blue circles, and are numbered (also in blue) from I to IX, inclusive.

The result of these borings is given in tabulated form on the accompanying sheet. It will be seen that the material consists chiefly of soft mud and some loose sand, and is supposed to be very easily dredged. Possibly, near Long Point a few bowlders may be met with.

CURRENTS.

As the velocities of the currents at this place did not appear to exceed 1½ to 2 miles per hour on an average, it was not deemed necessary to make any observations.

PROPOSED IMPROVEMENTS.

The improvement proposed to be made at this place consists in dredging a channel from deep water below Turner's Point to the deep water off Fickett's Point, called the "Deep Hole," the only available anchorage in the harbor. As this place is only accessible at or near high-tide for vessels navigating these waters, it is now of little value for vessels seeking shelter during heavy weather and at time of low-water. At present there is only 5½ feet of water at mean low-water, or 4 feet at extreme low-water, over the several bars crossing the channel. This improvement would also enable the steamers of the Portland, Bangor and Machias Steamboat Company, which touch at this port four times a week during the entire year, to land passengers and the heavy freights for this place at the lower steamboat wharf, whereas now they have to make the stop in the lower bay (except at high-water), and transfer passengers and freights on board of a lighter, at great expense and loss of time.

The channel above the "Deep Hole" being narrow and tortuous, is navigated mostly at or near high-water. Several ledges which project into this channel—one above the beacon, one off the upper steamboat wharf, and one above Sawyer's Wharf, all on the east side of the channel—have been closely surveyed, and are found to be of such extent as not to warrant their removal, especially as by buoying them out properly they can well be avoided, and are not considered dangerous to the navigation of this channel.

The great cost which the improvement of this portion of the channel would involve and the fact that vessels drawing 6½ to 7 feet of water can go up to the wharves from the "Deep Hole" at low-water, makes it appear unnecessary at the present time to recommend any work being done here.

Much of the lumber manufactured in the saw-mills at Cherryfield (about 7 miles above the draw-bridge) is shipped from the port of Millbridge. Vessels of the larger class are also built here at three different ship-yards.

It is therefore proposed to dredge a channel from the deep water below Turner's Point to the "Deep Hole" off Fickett's Point, having a width of 200 feet and a depth of 11 feet at mean low-water, which is believed to meet all the requirements of navigation at this place at the present time.

ESTIMATE.

Opening a channel, A–B, C–D, as shown on the accompanying sheet, shaded in red having a depth of not less than 11 feet at mean low-water, or 22.2 feet at mean high, water, and a least width of 200 feet, will require the removal of the following quantities of material:

Channel from A to B = 220,730 cubic yards, measured *in situ*.
Channel from C to D = 8,360 cubic yards, measured *in situ*.

Total .229,090 cubic yards, measured *in situ*, at 20 cents per cubic yard	$45,818
Engineering expenses and contingencies	4,182
Total cost of improvement	50,000

Very respectfully, your obedient servant,

A. C. Both,
Civil Engineer.

Bvt. Brig. Gen. Geo. Thom,
Colonel of Engineers, U. S. A

APPENDIX B.

IMPROVEMENT OF HARBORS AND RIVERS ON THE SOUTHERN COAST OF MASSACHUSETTS AND IN RHODE ISLAND—IMPROVEMENT OF CONNECTICUT RIVER.

REPORT OF LIEUTENANT COLONEL G. K. WARREN, CORPS OF ENGINEERS, BVT. MAJ. GEN. U. S. A., OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1881, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., August 13, 1881.

GENERAL: I have the honor to transmit herewith, my annual reports upon the works of river and harbor improvements and surveys under my charge during the fiscal year ending June 30, 1881.

Respectfully submitted.

G. K. WARREN,
Lieutenant-Colonel of Engineers,
Bvt. Maj. Gen., U. S. A.

THE CHIEF OF ENGINEERS, U. S. A.

B 1.

IMPROVEMENT OF HYANNIS HARBOR, MASSACHUSETTS.

During the fiscal year ending June 30, 1881, no work was done. By act of Congress approved March 3, 1881, $5,000 was appropriated.

Under date of May 11, 1881, advertisement was made inviting proposals for furnishing riprap granite to repair the slopes of the breakwater below low-water.

On June 8, the following proposals were received:

No.	Name and address.	Price per gross ton.	Commence.	Complete.
				1881.
1	Charles E. Davis, Wood's Holl, Mass	$1 69		October 31.
2	Joseph H. White, Hyde Park, Mass	2 13		Do.
3	Charles H. Edwards, Quincy, Mass	2 18		Do.
4	C. Y. Derry & Co., Boston, Mass	2 60		Do.

The contract was awarded to Charles E. Davis, the lowest bidder.

The available money, it is estimated, will be sufficient to complete, during the present season, the work of repairing and building up the slopes of the breakwater in accordance with the project adopted in 1874.

Mr. J. P. Cotton, assistant engineer, has superintendence of this work.

The wants of the future are, dredging to increase the depth within the protected area and changing the light-house to the east end of the breakwater and adding fog-signals.

Money statement.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount expended during fiscal year	50 62
July 1, 1881, amount available	4,949 38

B 2.

IMPROVEMENT OF NANTUCKET HARBOR, MASSACHUSETTS.

By act of Congress approved June 14, 1880, there was appropriated $50,000 for beginning this work.

A project for carrying on the improvement under this appropriation was submitted to the Chief of Engineers June 26, 1880. This was referred to the Board of Engineers for Fortifications and River and Harbor Improvements by the Chief of Engineers.

The project was returned by this Board to the Chief of Engineers with a report; it was then referred to the honorable Secretary of War and approved by him. The approved project was received from the Chief of Engineers October 25, 1880.

This project contemplates the building of a jetty from the shore west of the entrance to the harbor out to deep water outside of the bar, a distance of about 6,500 feet. During the progress of construction of this jetty, careful watch is to be kept by sounding and by making current observations of its effect.

It is expected that a jetty on the east side of the entrance will be required, as estimated for in the report of survey of 1879. If the western jetty fails to give the increased depth sought the eastern jetty will be commenced.

Under date of November 3, 1880, advertisement was made inviting proposals for furnishing riprap granite in the jetty.

The following is an abstract of proposals received and opened on December 3, 1880:

No.	Name and address.	Price per gross ton.	Commence.	Complete.
1	James Scully, Groton, Conn	$1 87	Mar. 1, 1881	Dec. 1, 1881
2	F. K. Ballou, Boston, Mass	1 88	Mar. 1, 1881	Dec. 1, 1881
3	Charles H. Edwards, Quincy, Mass	1 92	Mar. 1, 1881	Dec. 1, 1881
4	Clinton H. Stephens, Brooklyn, N. Y	2 74	Mar. 1, 1881	Dec. 1, 1881
5	John F. Rowe, Frankfort, Me	3 45	Mar. 1, 1881	Dec. 1, 1881

The contract was awarded to James Scully, Groton, Conn., and work under it was commenced April 26, 1881, and up to June 30, 1881, $3,989\frac{2}{10}$ tons of granite had been placed in the jetty.

The total length of the jetty is 850 feet.

It is too soon to see or predict the effect of the jetty in increasing the depth of water over the shoals.

A careful and comprehensive survey, extending from 1 mile west of the jetty to upwards of 2 miles east of it, has been made since the work began. This survey includes the harbor proper, and the shoal across the entrance, out to 18 feet depth at mean low-water. The area included in this survey covers more than 3 square miles, on which 19,000 soundings have been taken, each being located by two angles from a base on the shore.

The map of this survey is intended as a basis for future comparison of changes following the construction of the jetty. Surveys and current observations will be made during each month to discover the effect of the jetty.

By act of Congress approved March 3, 1881, $25,000 was appropriated for this improvement; but no attempt has yet been made to secure proposals for doing the work, it being thought best to await the experience we are gaining under the present contract.

The funds now available will not finish the west jetty. If it is left unfinished it is probable that the depth at the outer end and beyond will be increased by scour, thereby increasing the cost of the work and time of its completion. It is important that in case undue scour on Coatue point or shoal takes place we have funds in hand to at once attend to it. We have therefore asked for $75,000 for this work for the year ending June 30, 1883.

The superintendence of the work has been under J. P. Cotton, Assistant Engineer.

Money statement.

July 1, 1880, amount available	$50,000 00	
Amount appropriated by act approved March 3, 1881	25,000 00	
		$75,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	7,551 91	
July 1, 1881, outstanding liabilities	363 37	
		7,915 28
July 1, 1881, amount available		67,084 72
Amount (estimated) required for completion of existing project		149,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		75,000 00

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., October 18, 1880.

SIR: I beg leave to submit herewith a report from the Board of Engineers for Fortifications and River and Harbor Improvements, upon the plan proposed by Lieut. Col. G. K. Warren, Corps of Engineers, for the improvement of the harbor of Nantucket, Mass., for which an appropriation of $50,000 was made in the river and harbor act of June 14, 1880.

The plan is, in general terms, to improve the entrance of the harbor by jetties, which, it is believed, will have the effect of arresting the motion of the littoral sand and so concentrate the action of the tidal current as to scour and maintain a channel; and the project submitted by Lieutenant-Colonel Warren for the expenditure of the above appropriation contemplates its application towards the construction by contract of a jetty of riprap stone on the west side of the entrance to the harbor, commencing on the shore and extending out as far as the funds will admit.

The Board adopts this western jetty at the position advocated by Lieutenant-Colonel Warren, or 300 to 400 feet easterly from it, and recommends that it be extended as far as the currents continue capable of excavating the required depth. Should the deep water not be reached thereby an eastern jetty would be necessary.

The cost of the improvement is estimated approximately at $112,000, provided the west jetty will alone suffice, but if an eastern jetty also be required, at $180,000. And further, if it should be found necessary to carry out both jetties to deep water the approximate cost would become $238,000.

As the proportions in which the east and west jetties should be constructed, as well as their lengths, must be left to experience acquired in the progress of the work, these estimates indicate only the possible limits of cost.

Concurring in the views and conclusions of the Board I beg leave to suggest that the proposed plan of improvement be adopted, and that Lieutenant-Colonel Warren be instructed to proceed with the work in accordance with the recommendations of the Board.

Very respectfully, your obedient servant,

H. G. WRIGHT,
Chief of Engineers,
Brig. and Brt. Maj. Gen.

Hon. ALEXANDER RAMSEY,
Secretary of War.

[Indorsement.]

Recommendation of the Chief of Engineers approved.

By order of the Secretary of War:

H. T. CROSBY,
Chief Clerk.

WAR DEPARTMENT,
October 19, 1880.

REPORT OF THE BOARD OF ENGINEERS.

OFFICE OF BOARD OF ENGINEERS FOR FORTIFICATIONS
AND FOR RIVER AND HARBOR IMPROVEMENTS, &C.,
New York, August 23, 1880.

GENERAL: The Board of Engineers for Fortifications and Improvements of Rivers and Harbors, to whom was submitted the project of General G. K. Warren for the improvement of the harbor of Nantucket, under the provision of the river and harbor act appropriating $50,000 therefor, have the honor to submit the following report:

An examination of this harbor and the approaches thereto was made under the direction of the local engineer in 1874, and a report and map forwarded to the Chief of Engineers November 30, of the same year.

In 1879 a partial re-examination was likewise made and the results and conclusions embodied in General Warren's report and sketch of November 25, of that year.

As the whole amount allotted to these surveys was only $700, and was applied to examinations necessary for the discussion of several projects for improving the harbor and its approaches, the information obtained, although very important, did not suffice for an extended delineation of the exterior shoals formed to the east and west of the approaches to the present entrance. This might have proved valuable for comparison with the Coast Survey charts of an earlier date, by indicating changes in the shoals and the direction of the predominant drift of sand.

In default of observations thus extended through a series of years, the Board must rely upon the information furnished in the report of General Warren, which, indeed, appears to contain all the important facts now known and pertinent to the case.

The depth of water on the outer bar, and in the approaches to the entrance of the harbor, seems not to have varied from 6 feet at mean low-water from 1829 to the present time, and the mean rise being 3 feet, the navigable depth leading into the harbor is clearly defined.

The entire harbor comprises an interior basin between 5 and 6 miles long, separated from the waters of the sound by the long narrow Coatue Beach, the entrance to the harbor being at the western end of the basin.

The tidal basin is sufficient to maintain a strong current on the ebb which issues from the outlet between Brant and Coatue Points in a northwesterly direction, with sufficient force to excavate a deep channel having a least depth of 12 feet throughout, for the distance of three-fifths of a mile. The waters are then dispersed laterally, and the navigable depth until the outer bar is passed is only 6 feet at mean low-water.

General Warren, in his report of November 25, 1879, to which reference is respectfully requested for many interesting details, sums up the question of drifting sand as follows:

> Assuming, then, as reasonable that the sands at the Nantucket Bar came from the west through the Muskeget Channel, and are spread out over the sound, it is probable that the north winds and their waves drive this upon the hollow bend of the Nantucket shore, and that the littoral wave motion works the sand both east and west towards the entrance, as there is a sand spit on both sides, although that forming Coatue Beach on the east is much longer than that known as Brant Point on the west.
>
> The sand spits thus maintained by littoral sands moving towards the ends, approach each other as closely as the water entering and leaving the tidal basin will allow, and then the sand which reaches the ends is washed away by the current, some going to fill up the harbor, and some going to form the bar outside.
>
> The overlapping of the Coatue Point, shows that the supply from this direction exceeds that from Brant Point, and this condition gives a direction to the issuing or ebb current towards the northwest. But at the outer part of the bar (nearly 1 mile distant), the currents of the sound are nearly eastward, so that a new direction is given to the line of deepest water there, and the channel has for years past been moving eastward at its outer end.

The fact of the outlet being at the western end of the basin would indicate, in the absence of facts to the contrary, that the predominance of the sand drift along and near Coatue Beach has been from the eastward, but as no observations have been cited to show an advance of Coatue Point, or of the Coatue Flats, it cannot thence be assumed that the entrance at the present time is not in a state of equilibrium between the opposing drift from the east and the west, and the local currents.

However this may be, the Board, after a careful study of the maps and reports, and after a discussion of the facts involved with General Warren, are prepared to act upon the project of improvement presented.

General Warren's complete project is as follows:

> I, however, prefer the placing of the jetty on the west side of the entrance, keeping during its erection such a watch upon Coatue Point that no injurious change shall occur there.
>
> The jetty I propose is to be triangular in section, with side slopes of 45 degrees, the top to be 5 feet above mean low-water for a distance of 4,000 feet from the shore; the outer 2,500 being more exposed to the action of the waves, should be 4 feet wide on top, with the same side slopes and the same height. The outer end or head, being in deeper water, should have increased dimensions to meet the greater shock of the waves and effect of ice to which it will be exposed. The jetty is to be of large riprap stone, dropped immediately upon the line of the work, or, as it is a shallow bar and much exposed, it may be better to land the stone inside the harbor on Brant Point, and lay a railway track (probably a mile long) to carry the stone to the point on the shore where the jetty is to begin; continue the railway on piles out along the line of jetty, and drop the stone as the track advances.
>
> The following is the estimated cost of a jetty of the above description:
>
> 1st section, 4,000 feet, 7 tons of rip rap per linear foot, stone to average 1½ tons, 28,000 tons.

2d section, 2,500 feet, 12 tons per linear foot, stone to average 1¼ tons, 30,000 tons.

Total 58,000 tons at $1.75	$101,500 00
Add for contingencies	10,500 00
	112,000 00

It is thought that this improvement could be carried on to ultimately increase the depth to 12 or 14 feet or more, but to do this a second jetty may be required, which, in general terms, may double this estimate.

No benefit could result unless at least one jetty was completed; so it is urged, if the plan proposed to improve the present entrance is attempted, that the whole amount for the first jetty be appropriated in one, or, at most, two years.

His project of operations for the application of the appropriation of $50,000 is, in general terms, to construct by contract as much of the west jetty as the available funds will permit.

In his interview with the Board he also desired to reserve money enough to arrest injurious changes at Coatue or Brant's Point, and to make good measurements of currents and soundings before beginning work, as well as to watch the effect of the jetty as it progressed, by soundings and current measurements.

It has been suggested to construct a jetty, starting from Coatue Point and extending in a northwesterly direction, using the shore of the island as the other border of the channel. To reach deep water a long jetty would be necessary, and the channel must force its way through shoals formed and continually forming from the westerly drift. A channel under such conditions might be possible, but it is probable that another jetty to prevent the dispersion of the ebb currents would become necessary, and the great length of these structures would make the system too costly.

Suppose, on the other hand, a western jetty starting on the shore from the Bug Lights, or 300 to 400 feet east from these. This would for some distance outwards confine the currents and cause the excavation of a channel. But there would not probably be sufficient scour to give the required depth over the outer bar. Under those circumstances, two jetties would be required; but the location, extent, and character of the jetties must depend somewhat upon the collection of further data obtained as the work progresses.

The Board adopt the western jetty at the position advocated by General Warren, or 300 or 400 feet easterly from it, and recommend that it be extended as far as the currents continue capable of excavating to the required depth. Should the deep water not be reached thereby an eastern jetty starting from Coatue Beach would be necessary, having its inner portion, say to the 6-foot curve of the flats, held at a very low level, and its outer portion parallel in direction to the western jetty.

Estimating upon the basis of prices as given in General Warren's report, it is probable that the cost of this system would be $112,000, provided the west jetty alone will sufficiently deepen the approaches; in this case the shoals east of the jetty may so consolidate and confine the currents as to produce the desired effect. If the west jetty be carried out, say 4,000 feet, and the east jetty completed from its starting point on Coatue Point to the deep water of the sound, the approximate cost would be $180,000. The eastward current which is stated to be nearly constant may compress the outgoing currents against the projecting east jetty, and aid in deepening the channel to and beyond the outer bar. Finally if it should be found necessary to carry out both jetties to deep water, the approximate cost would be $238,000.

The proportions in which the east and west jetties should be constructed must be left to experience acquired on the spot, the estimates above indicate only the possible limits of cost.

The Board do not deem it expedient to enter further into detail, as they are fully impressed with the idea that a great deal may be supplied by further investigation of the physical features of the locality which would be useful if not necessary to the completion of the improvement.

General Warren's project of commencing with a western jetty is therefore approved by the Board with the modification of stopping it when an effective scour ceases, and it is recommended further that a portion of the present appropriation be reserved for the purposes heretofore named in this report.

The Board desires to append hereto General Warren's report of November 25, 1879, as supplying useful matter in detail and furnishing the prior history of this case. (Printed in Annual Report of Chief of Engineers for 1880, part 1, page 423.)

The locality was visited by one of the members of the Board who looked over the ground, and likewise conferred with prominent citizens of the place as to their views upon the character and extent of the improvement desired.

Respectfully submitted.

Z. B. TOWER,
Colonel of Engineers, Bvt. Maj. Gen., U. S. A.
JOHN NEWTON,
Colonel of Engineers, Bvt. Maj. Gen., U. S. A.

NOTE.—General Abbot is absent on leave.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

B 3.

IMPROVEMENT AT WOOD'S HOLL, MASSACHUSETTS.

The work during the fiscal year ending June 30, 1881, consisted in removing 44.7 cubic yards of bowlders of a size greater than 2 cubic yards, and 25.8 cubic yards of bowlders less than 2 cubic yards. This completed the work which had been prosecuted during the previous fiscal year, which is fully reported in the last annual report.

The balance on hand is too small to make any appreciable effect upon the channel as now used, and is reserved for contingencies.

The plan, as first estimated for in the report of survey in 1873, contemplated clearing out this passage between Buzzard's Bay and Vineyard Sound thoroughly, so as to permit its use by large sailing coasters. This would require a further appropriation of $430,000, but there appears to be no party engaged in navigation urging this at present.

This complete improvement may truly be called a national one. It is not for the benefit of any special locality. It is for a navigable highway uniting two large bodies of navigable water extensively used by the commercial vessels of the United States, and when thoroughly improved it will tend greatly to a saving of time and diminish the dangers of general coast navigation.

Appended to this report is one in detail by Assistant Engineer Mr. J. P. Cotton (who has superintended this work), giving the tidal observations at Wood's Holl, and a discussion of them. These phenomena are of peculiar interest at this point.

Money statement.

July 1, 1880, amount available	$1,622 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	716 26
July 1, 1881, amount available	905 74

REPORT OF MR. J. P. COTTON, ASSISTANT ENGINEER.

NEWPORT, R. I., *June* 30, 1881.

SIR: I have the honor to submit the following report of tidal observations made during the prosecution of the work of improvement in Wood's Holl Harbor, Massachusetts.

These observations were of high-water and low-water, of high-water slack and low-water slack.

They are inserted here as they show better than any description, the character of this passage and the difficulties attending works of improvement unless ample provision be made to meet them.

An examination of these tables shows that what is called "high-water slack" occurs some two hours after high-water, and "low-water slack" about the same length of time after low-water.

Observations on a gauge placed near the easterly end of Devil's Foot Island, about 1,200 *feet from the entrance of Wood's Holl Strait.*

Date.	High-water at—	Gauge reading.	High-water slack.	Gauge reading.	High-water slack after high-water.	Gauge fall on.
	h. m.	*Feet.*	*h. m.*	*Feet.*	*h. m.*	*Feet.*
April 19	3.45 p. m	2.9	5.40 p. m	2.1	1.55	0.8
20	4.40 p. m	3.0	6.20 p. m	2.1	1.40	0.9
21	5.50 p. m	2.9	7.30 p. m	1.8	1.40	1.1
22	6.40 a. m	2.4	8.30 a. m	1.8	1.50	0.6
23	7.30 a. m	3.1	9.20 a. m	2.0	1.50	1.1
24	8.15 a. m	2.9	10.10 a. m	2.0	1.55	0.9
25						
26	9.30 a. m	3.1	11.35 a. m	2.0	2.05	1.1
27	10.20 a. m	3.0	0.30 p. m	2.1	2.10	0.9
28	11.05 a. m	3.2	1.30 p. m	1.8	2.25	1.4
29	0.05 p. m	3.4	2.35 p. m	1.6	2.30	1.8
30						
May 5	5.20 p. m	3.1	7.35 p. m	1.7	2.15	1.4
6	6.10 p. m	2.6	8.45 p. m	2.0	2.35	0.6
7	6.50 p. m	3.0	9.15 p. m	2.1	2.25	0.9
8			20.40 a. m	1.1		
9						
10	9.20 a. m	2.2	11.45 a. m	1.1	2.25	1.1
11	10.00 a. m	2.1	0.40 p. m	0.8	2.40	1.3
12	10.40 a. m	2.4	1.10 p. m	1.1	2.30	1.3
13	11.15 a. m	2.3	1.40 p. m	1.4	2.25	0.9
14	11.45 a. m	2.5	2.15 p. m	1.4	2.30	1.1
15	0.20 p. m	2.3	3.00 p. m	1.5	2.40	0.8
16						
17	1.50 p. m	3.0	4.05 p. m	2.2	2.15	0.8
18	2.55 p. m	3.1	5.20 p. m	2.1	2.25	1.0
19	3.35 p. m	3.1	6.20 p. m	2.0	2.45	1.1
20	4.40 p. m	3.2	7.00 p. m	2.1	2.20	1.1
21	5.30 p. m	3.1	8.00 p. m		2.30	
22	5.50 p. m	3.1	8.45 p. m	1.1	2.55	2.0
23						
24	7.45 a. m	3.0	10.40 a. m	1.0	2.55	2.0
25	8.50 a. m	3.4	11.15 a. m	1.4	2.25	2.0
26	9.40 a. m	3.2	0.20 p. m	1.3	2.40	1.9
27	10.30 a. m	3.2	1.20 p. m	1.4	2.50	1.8
28	11.10 a. m	3.1	1.55 p. m	1.4	2.45	1.7
29						
30						
31	2.30 p. m	2.9	5.12 p. m	1.7	2.42	1.2

Observations on a gauge placed near the easterly end of Devil's Foot Island, &c.—Cont'd.

Date.	High-water at—	Gauge reading.	High-water slack.	Gauge reading.	High-water slack after high-water.	Gauge fall on.
	h. m.	*Feet.*	*h. m.*	*Feet.*	*h. m.*	*Feet.*
June 1	3.30 p. m	2.9	6.15 p. m	2.0	2.45	0.9
2	4.25 p. m	2.9	7.10 p. m	2.0	2.45	0.9
3	5.10 p. m	3.2	7.15 p. m	1.7	2.05	1.5
4	6.00 p. m	3.1	8.25 p. m	1.3	2.25	1.8
5		.....	9.20 a. m	.....	.....	.....
6		.....		.....	.....	.....
7	8.20 a. m	2.9	10.40 a. m	1.6	2.20	1.3
8	9.00 a. m	.....	11.15 a. m	2.0	2.15	.....
9	9.50 a. m	2.5	11.45 a. m	1.7	1.55	0.8
10	10.15 a. m	2.4	0.10 p. m	1.5	1.55	0.9
11	10.35 a. m	2.6	1.20 p. m	.....	2.45	.....
12	11.25 a. m	2.5	1.55 p. m	1.3	2.30	1.2
13		.....		.....	.....	.....
14	0.50 p. m	3.2	3.10 p. m	2.2	2.20	1.0
15	1.45 p. m	3.1	3.55 p. m	2.2	2.10	0.9
16	2.30 p. m	3.0	5.00 p. m	2.3	2.30	0.7
17	3.25 p. m	3.2	5.50 p. m	2.3	2.25	0.9
18	4.20 p. m	3.3	6.45 p. m	2.6	2.25	0.7
19	5.15 p. m	.....	7.30 p. m	.....	2.15	.....
20		.....		.....	.....	.....
21	7.00 a. m	4.2	9.25 a. m	2.4	2.25	1.8
22	8.00 a. m	4.2	10.15 a. m	2.5	2.15	1.7
23	8.50 a. m	3.2	11.05 p. m	1.8	2.15	1.4
24	9.40 a. m	3.5	12 m	2.2	2.20	1.3
25	10.35 a. m	3.4	0.55 p. m	2.1	2.20	1.3
26	11.35 a. m	3.3	1.50 p. m	2.0	2.15	1.3
27		.....		.....	.....	.....
28	1.30 p. m	3.0	3.40 p. m	2.1	2.10	0.9
29	2.20 p. m	2.9	4.40 p. m	2.0	2.20	0.9
30	3.10 p. m	2.5	5.30 p. m	2.1	2.20	0.4

This record shows that high-water slack (slackwater nearest to high-water) may occur from 1 hour 40 minutes to 2 hours 55 minutes after high-water. The average of the above observations is 2 hours 13 minutes. Its occurrence as to time is quite irregular, and no difference was observed as to this in spring or neap tides.

The height on the gauge of high-water slack shows as great irregularity as the time of its occurrence; it was from 0.4 to 2.6 feet below the preceding high-water; it averaged 1.2 feet below.

Date.	Low-water at—	Gauge reading.	Low-water slack.	Gauge reading.	From low-water to low-water slack.	Difference in gauge readings.
	h. m.	*Feet.*	*h. m.*	*Feet.*	*h. m.*	*Feet.*
April 19	9.50 a. m	0.9	11.50 a. m	1.8	2.00	0.9
20	10.45 a. m	1.0	0.10 p. m	1.5	1.25	0.5
21	11.50 a. m	1.0	1.20 p. m	1.4	1.30	0.4
22	0.30 p. m	1.1	2.35 p. m	1.4	2.05	0.3
23	1.25 p. m	1.1	3.15 p. m	1.4	1.50	0.3
24	2.15 p. m	0.9	4.15 p. m	1.2	2.00	0.3
25		.....		.....	.....	.....
26	4.15 p. m	1.0	6.00 p. m	1.5	1.45	0.5
27	4.50 p. m	0.9	6.40 p. m	1.3	1.50	0.4
28	5.30 p. m	0.8	7.35 p. m	.....	2.05	.....
29	6.10 p. m	0.8		.....	.....	.....
30		.....		.....	.....	.....
May 5	11.00 a. m	1.0	1.30 p. m	1.4	2.30	0.4
6	0.05 p. m	0.9	2.20 p. m	.....	2.15	.....
7	1.00 p. m	0.5	2.55 p. m	1.0	1.55	0.5
8	1.50 p. m	0.6		.....	.....	.....
9		.....		.....	.....	.....
10	3.30 p. m	0.4	5.30 p. m.	1.0	2.00	0.6

Observations on a gauge placed near the easterly end of Devil's Foot Island, &c.—Cont'd.

Date.	Low-water at—	Gauge reading.	Low-water slack.	Gauge reading.	From low-water to low-water slack.	Difference in gauge readings.
	h. m.	*Feet.*	*h. m.*	*Feet.*	*h. m.*	*Feet.*
May 11	4.00 p. m	0.6	6.20 p. m	1.4	2.20	0.8
12	4.50 p. m	0.8	6.50 p. m	1.0	2.00	0.2
13	5.40 p. m	0.8	7.35 p. m	1.2	1.55	0.4
14	6.30 p. m	0.8	8.00 p. m	1.3	1.30	0.5
15	7.00 p. m	1.0	8.55 p. m	1.2	1.55	0.2
16	......	......	......	......	......	......
17	7.55 a. m	1.0	10.15 a. m	1.7	2.20	0.7
18	9.00 a. m	1.1	11.10 a. m	1.4	2.10	0.3
19	9.55 a. m	1.0	12.00 m	1.5	2.05	0.5
20	10.40 a. m	0.8	0.85 p. m	1.5	1.55	0.7
21	11.30 a. m	0.5	1.50 p. m	1.2	2.20	0.7
22	11.55 a. m	0.3	2.25 p. m	1.3	2.30	1.0
23	......	......	......	......	......	......
24	1.30 p. m	0.1	4.00 p. m	0.9	2.30	0.8
25	2.30 p. m	0.3	......	......	......	......
26	3.20 p. m	0.4	6.12 p. m	1.1	2.52	0.7
27	4.25 p. m	0.6	6.45 p. m	0.8	2.20	0.2
28	5.15 p. m	0.6	7.35 p. m	1.0	2.20	0.4
29	......	......	......	......	......	......
30	......	......	......	......	......	......
31	8.10 a. m	0.8	10.25 a. m	1.2	2.15	0.4
June 1	8.45 a. m	0.8	11.15 a. m	1.4	2.30	0.6
2	9.35 a. m	0.9	0.25 p. m	1.5	2.50	0.6
3	10.50 a. m	......	1.20 p. m	1.7	2.30	......
4	11.40 a. m	0.7	1.50 p. m	1.4	2.10	0.7
5	0.10 p. m	0.6	......	......	......	......
6	......	......	......	......	......	......
7	2.00 p. m	1.0	3.58 p. m	2.1	1.58	1.1
8	2.50 p. m	0.9	4.50 p. m	......	2.00	......
9	8.20 p. m	0.6	5.15 p. m	1.3	1.55	0.7
10	4.15 p. m	0.5	6.00 p. m	1.5	1.45	1.0
11	4.50 p. m	0.5	6.35 p. m	1.2	1.45	0.7
12	5.35 p. m	0.7	7.50 p. m	1.2	2.15	0.5
13	......	......	......	......	......	......
14	6.00 p. m	......	8.15 p. m	1.8	2.15	......
15	7.10 a. m	0.9	9.55 a. m	1.8	2.45	0.9
16	7.55 a. m	1.0	10.40 a. m	1.7	2.45	0.7
17	8.30 a. m	0.9	11.20 a. m	1.6	2.50	0.7
18	9.40 a. m	0.6	0.25 p. m	1.4	2.45	0.8
19	10.30 a. m	......	1.20 p. m	......	2.50	......
20	......	......	......	......	......	......
21	9.35 p. m	0.4	3.20 p. m	1.5	2.45	1.1
22	1.30 p. m	0.4	4.15 p. m	1.4	2.45	1.0
23	2.30 p. m	0.4	3.20 p. m	1.5	2.45	1.1
24	3.30 p. m	0.5	5.55 p. m	1.3	2.25	0.8
25	4.30 p. m	0.6	6.45 p. m	1.3	2.15	0.7
26	5.35 p. m	0.5	7.15 p. m	0.9	1.40	0.4
27	......	......	......	......	......	......
28	7.10 p. m	0.9	9.05 p. m	1.4	1.55	0.5
29	8.00 a. m	0.9	9.45 p. m	1.4	1.45	0.5
30	8.30 a. m	1.3	10.50 p. m	1.6	2.20	0.3

"Low-water slack" as recorded in the above table occurs from 1 hour 25 minutes to 2 hours 52 minutes after low-water; the average of these observations is 2 hours and 7 minutes. The rise on the gauge varies equally with the difference of time, but seems to bear no relation to it; some days when the time between low-water and low-water slack was more than the average the change in the level of the water's surface was the minimum.

The differences in the reading of the gauge at low-water and low-water slack appear in the above table; they are from 0.2 to 1.1 feet, the mean difference being 0.60 feet above.

Mean low-water, as determined from all the observations made, read 0.62 on this gauge.

Mean low-water slack, 1.37.

Mean high-water slack, 1.76.

Mean high-water, 2.87.

The mean rise and fall of the tide, 2.25 feet.

The rise of the highest tide observed, above mean high-water was 1.33 feet.

The fall of the lowest tide observed, was 0.32 below mean low-water, giving an extreme range of 3.9 feet.

During November and December, 1879, the work of removing bowlders was carried on by divers. A record was kept of the time that they were able to work, both at the low-water slack and the high-water slack. The diver went down as soon as the current would permit, and remained as long as he could work against the current.

The time at high-water slack varied from 20 minutes to 2 hours; the average was 1 hour and 5 minutes.

The time at low-water slack varied from 20 minutes to 3 hours 45 minutes; the average was 2 hours.

Very respectfully,

J. P. COTTON,
Assistant Engineer.

General G. K. WARREN,
Lieutenant-Colonel of Engineers, U. S. A.

B 4.

IMPROVEMENT OF WAREHAM HARBOR, MASSACHUSETTS.

A survey of this harbor was made during the fiscal year in compliance with the provision of the river and harbor act of June 14, 1880. The report upon this survey gives in detail the condition and desired improvement of this harbor. It was printed as House Ex. Doc. No. 18, Forty-sixth Congress, third session. It accompanies this report.

By act of Congress approved March 3, 1881, $10,000 was appropriated for this improvement. It is proposed to expend $7,000 of this in dredging in the shoalest parts of the channel to 9 feet depth at mean low-water, to allow vessels drawing 13 feet to reach the wharves at high-water, the mean rise of tide being 4 feet. Advertisements were issued May 11, 1881, inviting proposals for doing this work.

The following is an abstract of tenders received on June 8, 1881:

No.	Name and address.	Price per cubic yard.	Commence.	Complete.
1	John McDermott, Cohoes, N. Y	$0 24⅛		June 30, 1882
2	J. H. Fenner, Jersey City, N. J	28	April 1, 1882	June 30, 1882

A contract has been entered into with John McDermott, the lowest bidder.

The work will be commenced on or before October 15, 1880, and probably completed before winter.

With the $3,000 remaining of the appropriation, it is proposed to strengthen the sand-catch fence on Long Beach, and build spurs to it, beginning in the lowest part of the beach. This work is to be done by purchasing material in open market, and by hired labor.

In this way we are able to watch the effect of the work as it progresses, and modify the fence to meet it.

The estimated cost of the completed project was $44,050. It is thought that $20,000 could be advantageously expended in the fiscal year ending June 30, 1883.

This work is in the superintendence of J. P. Cotton, assistant engineer.

Money statement.

Amount appropriated by act approved March 3, 1881	$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	113 19
July 1, 1881, amount available	9,886 81
Amount (estimated) required for completion of existing project	34,050 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	20,000 00

SURVEY OF WAREHAM HARBOR, MASSACHUSETTS.

ENGINEER OFFICE, UNITED STATES ARMY,
Newport, R. I., December 13, 1880.

GENERAL: I have the honor to send herewith a report and map of the survey of Wareham Harbor, Massachusetts, assigned to me under the act of Congress passed at its last session. This work has been done under my direction by Assistant J. P. Cotton.

The map and report fully show the present condition of the harbor. There has been some shoaling at the "upper bar," but the general result is a very favorable exhibition of an improvement that has been as permanent as could reasonably be expected.

Passage in and out of this harbor is altogether dependent upon sails, and not only is there a want of increased depth where the new shoal is formed, but some further widening and straightening to permit of "beating" in and out.

The reliance is upon a high-water depth of 13 feet (the rise being 4 feet), and this lets in the large coasting schooners having considerable length.

It is also felt to be very desirable to secure a permanence to Long Beach, which protects the entrance to the harbor. This our experimental work there shows to be feasible if made with substantial material.

Estimates are submitted for both these objects:

(1.) For work on Long Beach	$15,000
For dredging to deepen and widen	23,050
For dredging to remove middle ground	6,000
	44,050

Wareham is in the New Bedford collection district. The amount of revenue collected during the fiscal year ending June 30, 1880, was $15,842.69.

The interests affected by or concerned in the improvement of this harbor are fully set forth in Mr. Cotton's report.

Very respectfully,

G. K. WARREN,
Lieutenant-Colonel Engineers,
Bvt. Maj. Gen., U. S. A.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. JOSEPH P. COTTON, ASSISTANT ENGINEER.

ENGINEER OFFICE, UNITED STATES ARMY,
Newport, R. I., December 1, 1880.

GENERAL: I have the honor to submit the following report on the survey of Wareham Harbor, Massachusetts, provided for in section 2 of the river and harbor act approved June 14, 1880.

The field work of the survey was completed between August 12 and August 20, with the assistance of William H. Lawton, jr., and J. A. Curtis, inspectors.

GENERAL DESCRIPTION OF THE HARBOR.

This harbor is an estuary of Buzzard's Bay. It is about 13 miles east of New Bedford, and 6 miles west of Monument, the southern end of the proposed Cape Cod ship canal.

It is about 3 miles in length, with a width varying from 200 feet to more than half a mile.

Into this estuary empty Agawam River at its head, draining about 45 square miles; Broad Marsh River on the west side, draining 4 square miles; and Weweantic River on the west side, below Long Beach, draining 95 square miles.

A small stream, called Crooked River, draining but 1 square mile, empties into it from the east.

The shores for the most part are low, with extensive marshes that are submerged by spring-tides.

The harbor, commencing at the rail and highway bridges at Wareham, which, not being provided with draws, prevent any navigation above them except by barges, is about 200 feet wide. At the south end of the Franconia Iron Company's wharf, 1,400 feet further down, it is 400 feet wide; from this point it opens out into a bay 2,000 feet in width. Near the mouth of Broad Marsh River it narrows to about 900 feet, which width it retains for about 1,200 feet, when it again widens into a bay more than ½ a mile wide.

This bay is separated from Buzzard's Bay by Long Beach, which extends from the east shore out about 2,000 feet. This beach is composed of sand. At low-water level the sand is coarse, with gravel and pebbles; above low-water it is fine, and easily moved by wind or waves. The width of the beach at low-water varies from 200 to 800 feet; at ordinary high-water a narrow strip of sand, not more than 100 feet wide in the widest part, is above water. At high-water of spring-tides the whole beach is submerged.

Outside of this beach is an extensive shoal or flat, the curve of 6-foot depth being ½ of a mile distant at the east end, and more than ½ a mile at the west end. The water on the inside of this beach is bold; at the west end of it a vessel drawing 9 feet can at low-water approach within 50 feet of the high-water line.

PREVIOUS SURVEYS.

A survey of this harbor was made in 1870, under the direction of the harbor commissioners of Massachusetts. The report upon this survey appears in their Fifth Annual Report, 1871, and is as follows:

"During the past year the board has had made a careful survey of Wareham River, with a view to the establishing proper harbor lines and the determination of the causes that have led to the formation of shoals near the wharves. They also have in mind to apply to Congress for the removal of the bar that has formed at the mouth of the river, should the results seem to justify such action. The great importance of this port, and the extensive manufactures carried on there, call for a serious effort to improve the navigation of this river, upon which the prosperity of the place almost wholly depends."

In their next annual report a comparison is made between the condition of the harbor in 1845, as shown by the United States Coast Survey, and by their survey of 1870. This comparison showed that marked changes had taken place in the upper part of the river. Of this they say: "It can hardly be questioned that the construction of the solid pier between the west side of the river and the sluice-way, or bay, through which scows and boats now pass, and the solid embankment of Cape Cod Railroad on the west side of the river, together with the stone ballast which has been thrown around and between the piers of both the railroad and town bridges, have contributed mainly to the injury sustained, and have caused the violent and unequal currents which have dug out, as it were, the deep holes above, between, and below the bridges, and thrown up the abrupt and injurious shoals beyond them."

The injurious effects of the bridge structures they think is "confined to about the first 400 feet below them."

In regard to these they say: "While there is no doubt that the physical condition of this upper portion of the river could be improved by the removal of the railroad embankment, the whole, or a part, of the solid pier near the center of the river, the stone ballast from under each of the bridges, and the reconstruction of the railroad piers, it would be a measure of doubtful economy. It is the opinion of the board that the river could be improved, and the improvement maintained, for a much less sum than it would take to remove and remodel the objectionable portions of the existing structures."

Harbor lines were established by the board on both sides of the river from the bridges at the upper end to Barney Point.

In 1871 a survey was made under direction of General George Thom, United States Engineers, in accordance with the resolution of the House of Representatives. The report upon this survey, including estimates for improving the channel, was published in the Annual Report of the Chief of Engineers for 1872, pages 973–976.

The map of the survey of the harbor made in 1870 by Professor H. L. Whiting for the harbor commissioners was used as a basis for the survey of 1871, under General Thom. Additional soundings were taken and current observations made on the flood and ebb tides at the railroad bridge and at Quahaug Bar. The soundings were reduced to the plane of mean low-water established in 1870.

The plan of improvement estimated for and recommended by General Thom was dredging a channel 250 feet wide and 9 feet deep at mean low-water through Quahaug Bar, and straightening and widening the channel through the "upper bar"; estimate was also made for removing a large bowlder near the mouth of Weweantic River, the whole to cost $45,000.

HISTORY OF IMPROVEMENTS MADE.

In 1872 Congress made an appropriation of $10,000 for the improvement of this harbor; another appropriation of $10,000 was made in 1873; $10,000 in 1874, and $10,000 in 1875, making a total of $40,000. Dredging was commenced in 1873 and completed in 1876, making a channel from 250 to 300 feet wide and 10 feet deep at mean low-water from Long Beach around Quahaug Bar; thence, by cutting off shoal points, a least width of 200 feet was made to the "upper bar." Thence to the bridge, at the upper end of the harbor, the width decreased to 100 feet; the depth made in this part was 9 feet at mean low-water.

During the progress of the improvement in 1873 a detailed survey of the harbor was made, as the maps of previous surveys were not sufficiently in detail to serve as a guide in carrying on the works of improvement. This survey showed that there was less depth of water in the harbor than had been previously supposed.

The report of this survey was published in the Annual Report of the Chief of Engineers for 1874, pages 216–220.

On the completion of the improvement above described there was about $1,700 remaining on hand. With this an attempt was made, in 1877, to catch the sand brought along the south side and over Long Beach into the harbor, by building a sand-catch fence. This fence was of a single row of cedar trees on the higher parts, and on the lower parts of two rows of posts 4 feet apart, connected by stringers and ties placed 1 foot below the surface of the sand. The space between these two rows of posts was filled with brush to about 2 feet above the general surface, this brush being held in place by small stone.

In a storm, accompanied by a very high tide, in the following October, a portion of this fence was washed away. In July, 1878, it was rebuilt, and loaded with larger stone.

The removal of the bowlder in Weweantic River, estimated for in the report of General Thom, was not undertaken because there was no longer any demand for it.

SURVEY AND MAP.

The survey of this season was confined to the channel dredged in 1873–1876, and to the part outside of Long Beach not included in previous surveys. A map of the harbor from the bridges to the "four buoys," outside of Long Beach, on a scale of 200 feet to an inch, accompanies this report. This map shows the present condition of the channel, the depth on the flats and in coves from survey in 1873, the harbor lines as established by the harbor commissioners in 1871, and the channel desired by those interested in the commerce of Wareham, and for which estimates are made.

PRESENT CONDITION OF THE HARBOR.

Beginning at the bridges at the upper end of the harbor we find in the deep hole, which is undoubtedly caused by the obstruction formed by the embankments and piers and riprap protection of the bridges, a depth of 26 feet at mean low-water, the same as in 1873. Immediately below this the shoal with the dredged channel along the wharves to the west has a depth of but 4.1 feet on it. This shoal has increased in size and now encroaches upon the channel, leaving a width of but 70 feet with 8 feet depth.

From this shoal to the "upper bar," which begins about 900 feet below the Franconia Iron Company's wharf, the dredged channel has about the same general width and depth as when completed. In some places it has widened by scour and in some narrowed by deposit.

The channel dredged through the "upper bar," 150 feet wide and from 9 to 10 feet deep at mean low-water, has filled up so that in the shallowest place there is but little more than 7 feet depth at mean low-water. This filling is over the whole width of the channel and for 600 feet along it.

From this bar to the entrance of the harbor at Long Beach but little change has taken place in the dredged channel.

At Quahaug Bar it has narrowed somewhat by filling in from the bar, or northwest side of the channel, and widened on the opposite side by scour.

There is now a channel not less than 100 feet wide and 9 feet deep at mean low-water from the entrance to the "upper bar." The mean rise of tide is about 4 feet, so that vessels drawing about 13 feet can go to the "upper bar" at mean high-water, but cannot cross it drawing more than 11.5 feet.

The fence on Long Beach, built to catch the moving sand, is in very good condition, and for much of its length sand has collected about it nearly up to the level of high-water. On the part of the beach above ordinary high-water the sand is blown about by the wind so that its height is not much increased by the fence. A storm from the south will fill the sand in along the fence that will be blown out into the water by a northerly wind.

PROPOSED IMPROVEMENT.

From a consultation with those interested in the navigation of this harbor I learned that the depth of the channel made in 1873-'76 was deemed by them sufficient for the class of vessels likely to be employed in the commerce of the place, if that depth can be maintained.

The width of channel made, they say, is too small to allow vessels to beat in or out, and for this reason valuable time is lost by vessels that come to this port.

This want of width for beating is particularly felt above Barney Point and through the "upper bar." Some trouble is found in getting through the channel at Quahaug Bar, but less than in the upper part.

To meet these requirements will require that the channel through the "upper bar" be made 350 feet wide. The entire removal of the "upper bar" is wanted by those interested, so as to make the pocket of deep water to the east, now used for anchoring boats in, available for beating in, but the harbor lines, as established, place part of this pocket of deep water inside of the pier-head line.

Estimate is made for dredging the entire space on the "upper bar" east of the present channel to the harbor line on the east side. This would give a width of 350 feet. This is a greater width than is proposed below, and will require the removal of a large amount of material. We have therefore made an estimate for a channel 200 feet wide through this bar. Thence to Barney Point to widen and straighten the channel to 200 feet and 10 feet depth. From Barney Point to the entrance of the harbor to make the channel 250 feet wide in its narrowest part and 10 feet deep.

A depth of 10 feet is made so that when the sides of the cuts are washed down by the waves, and by vessels striking them, there will be still a least depth of 9 feet.

The fence already built on Long Beach seems to have determined the feasibility of holding and building up this beach above high-water, and in that way cut off one of the sources of supply of sand that now finds its way into the harbor.

The growth of the shoal, of which this beach is the inner margin, and its encroachment upon the lower part of the harbor, have been considerable within the memory of those who sail out of the harbor. A map of Wareham, made by S. Bourne in 1832, shows a wide opening near the eastern shore, and a shoal outside of it. Through this opening boats went in and out to the fishing grounds.

This map does not give the depth of water. The map of the United States Coast Survey, made in 1845, is the earliest one on which the depth of water is shown. Since that date the filling has been going on slowly, but the beach is not likely to become permanent unless it is raised above storm tides and the sand held against the action of the winds by vegetation.

To do this it will be necessary to build a sand-catcher on the site of the present fence; this to be of brush loaded with stone; it should be built above storm tides. From this, spurs should be built on the south side; these would not require to be so high or strong as the main line. They should be built by beginning at the lowest point of the beach and building one at first. When the sand fills out to the end of it another may be built, and so on until the whole beach is widened and raised. As soon as any portion of the beach is above spring-tides, it should be planted with beach grass to prevent the sand being blown away.

Some complaint is made of the narrow channel at the "four buoys," about ½ of a mile below the "beach." An examination of it showed a channel 12 feet deep at mean low-water, with a least width of 125 feet, with bowlders on either side of it.

We could not learn that any serious trouble had been experienced here, and as it is better than we propose to make the channel further up the harbor, no estimate is made for its improvement.

Pilots find some trouble in coming into the harbor in thick weather or near night from their inability to see the westerly end of Long Beach. If they cannot see it, and get out of their course to the eastward, they get ashore on the Long Beach flats. It is thought that a "day beacon" should be built on the west end of the "beach," and thus this danger avoided or lessened.

ESTIMATES.

First estimate:

Dredging 60,000 cubic yards from channel near bridge and through "upper bar," 350 feet wide, mud and sand, at 25 cents	$15,000 00
Dredging 15,000 cubic yards, in widening the channel from "upper bar" to Barney Point, mud and sand, at 25 cents	3,750 00
Dredging 24,000 cubic yards of sand, in widening the channel at Quahaug Bar	6,000 00
Removal of bowlder from channel upper side of Quahaug Bar	300 00
For holding Long Beach, 2,000 cords of brush, in place, at $2	4,000 00
4,000 tons of stone on beach, at $2	8,000 00
Building spurs, 20, at $100	2,000 00
Planting beach	1,000 00
Add for contingencies	4,000 00
Total	44,050 00

Second estimate:

Same as the first, except the channel through the "upper bar" is 200 feet wide instead of 350.

Dredging 36,000 cubic yards from channel near bridge and through "upper bar"	$9,000 00
The other items same as in first estimate	25,050 00
	34,050 00
Add for contingencies	4,000 00
	38,050 00

The commercial interests of Wareham, are largely dependent upon water transportation to this port.

The registered tonnage of sailing vessels owned in and hailing from Wareham in 1879 aggregated above 6,000 tons. The harbor is, by its railway facilities, a seaboard distributing point for inland towns and for Cape Cod. Steamboat connection is made here with summer resorts in Buzzard's Bay; and upon the wharf tracks of the Old Colony Railroad Company cargoes are received and delivered directly from and into vessels lying in their berths.

* * * * * * *

Respectfully submitted.

JOSEPH P. COTTON,
Assistant Engineer.

Bvt. Maj. Gen. G. K. WARREN,
Lieutenant-Colonel, Corps of Engineers, U. S. A.

B 5.

IMPROVEMENT OF TAUNTON RIVER, MASSACHUSETTS.

At the beginning of the present fiscal year there was available for this work $17,500, appropriated by act of Congress approved June 14, 1880.

Under date of July 24, 1880, advertisement was made, inviting proposals for dredging a channel 11 feet deep at mean high-water, beginning at the highway bridge at Weir.

The following is an abstract of proposals received and opened on August 14, 1880:

No.	Name and address.	Price.	Commence.	Complete.
1	Wm. Flannery, No. 60 South st., New York, N. Y..	$0 47	Sept. 1, 1880	June 30, 1881.
2	Staples & Phillips, Taunton, Mass	56¾	At once	June 30, 1881.
3	McDermott & Daly, Cohoes, N. Y	59		June 30, 1881.
4	Frank Pidgeon, New York, N. Y	87	Within 30 days	June 30, 1881.
5	E. M. Payn, Albany, N. Y	89	Nov. 1, 1880	June 30, 1881.
6	S. A. Hammond, Bridgeport, Conn	98		June 30, 1881.
7	Elijah Brainard, New York, N. Y	1 15	Sept. 20, 1880	June 30, 1881.
8	James Caler & Son, Stamford, Conn	1 29	Oct. 15, 1880	June 30, 1881.

A contract was made with the lowest bidder, William Flannery, of No. 60 South street, New York City, dated August 25, 1880.

Work was commenced in August, and continued until ice stopped it in the latter part of November. The amount of material removed was 12,190 cubic yards in making a channel 11 feet deep at mean high-water, and 40 to 60 feet wide, for 3,100 feet from the bridge at Weir down river. The material removed was sand and coarse gravel, with an occasional bowlder. Work was begun at the upper end instead of the lower of the improvement, to make berth room for loaded vessels at low-water; as they go up or down only at or near high-water; drawing the full depth they must ground before getting through if not lightered.

The contractor has not yet resumed work. The unusually severe winter prevented any work being done from December 1 to the middle of March, so that he was unable to complete what he had expected to do in the winter until June. His contract has been extended, and it is expected that he will resume work early in July.

By act of Congress, approved March 3, 1881, $25,000 was appropriated for continuing this improvement.

Under date of May 11, 1881, advertisement was issued inviting proposals for continuing the work.

The following is an abstract of the bids received and opened June 8, 1881.

No.	Name and address.	Price per cubic yard.	Commence.	Complete.
1	W. H. Beard, Brooklyn, N. Y	$0 49½	Mar. 10, 1882.	June 30, 1882
2	Wm. Flannery, New York City, N. Y	55		June 30, 1882
3	John McDermott, Cohoes, Albany County, New York..	60		June 30, 1882
4	Staples & Phillips, Taunton, Mass	98	Within 15 days.	June 30, 1882
5	New England Dredging Company, Boston, Mass	1 00		June 30, 1882

The contract was awarded to the lowest bidder, William H. Beard, the work to commence September 15, 1880, instead of the date named in his proposal

The project to give 9 feet depth at mean high-water, completed in 1880, required dredging only certain well-defined shoals. These had been carefully surveyed and maps made of them Of the intervening portions of the river no survey had been made since that by Lieutenant Rosecrans, United States Engineers, in 1852. The plane of reference to which his soundings were reduced was referred to a bench-mark that could not be found. The adoption of the project to make 11 feet depth at mean high-water made the improvement almost continuous from Dighton to Weir.

It was therefore necessary that a survey be made of the portions between the shoals. This has been done during the months of May and June. The results of this survey will enable us to make a complete map of the river. It will also give the necessary data to correct the estimates for completing the improvement, which will be done during the next fiscal year.

The available funds, it is expected, will complete the improvement from the bridge down to the lower end of Pond Rock Shoal, a distance of 2½ miles.

The amount estimated as necessary to complete the existing project, to give an available depth of 11 feet at mean high-water up to Weir, is $41,500.

This amount could be advantageously expended in the fiscal year ending June 30, 1883. The improvement is of but little value to the commerce of the river until completed, as all or nearly all of the business is done at or above Weir.

This work has been under the superintendence of J. P. Cotton, Assistant Engineer:

Money statement.

July 1, 1880, amount available	$17,500 00	
Amount appropriated by act approved March 3, 1881	25,000 00	
		$42,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	7,352 73	
July 1, 1881, outstanding liabilities	572 92	
		7,925 65
July 1, 1881, amount available		34,574 35
Amount (estimated) required for completion of existing project		41,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		41,500 00

B 6.

IMPROVEMENT OF PAWTUCKET (SEEKONK) RIVER, RHODE ISLAND.

At the beginning of this fiscal year there was an unexpended balance of $529.58, which still remains for contingencies. The project as far as adopted and approved is completed.

The commission appointed by the State of Rhode Island to consider the obstructions caused by the bridges at India Point, at the mouth of the river, reported to the legislature a plan for doing away with both the present railway and highway bridges and substituting a combination bridge, located between the old bridges, with the highway on top and the railway underneath. The proposed bridge was to have a draw 80 feet wide on each side of the pivot pier.

If this plan should be adopted and the bridge built on piers occupying the smallest practicable sectional area, and the foundation of the old bridges were completely removed, the necessities of the navigation interests of this river would be well provided for; but unfortunately for these interests, others which conflict with the proposed plan render its adoption improbable. The principal obstruction is the highway bridge with its narrow draw span, and the tidal obstructions caused by the foundations of the bridge, which create a very dangerous current there.

The railway bridge, while having a badly located draw span, offers very little obstruction to the flow of water, and with some small changes could be safely and easily navigated, if the draw span of the highway bridge were properly located and the obstructions to the tidal flow removed.

No appropriations for this improvement have been recommended or made since 1873.

The obstructions at these bridges render any further improvement comparatively useless.

The increase in the size and draught of vessels of late years makes it desirable that the ruling mean low-water depth should be increased to 9 feet. This could probably be done for an additional appropriation of $33,000, which could be profitably expended in one year. This dredged material would have to be towed out of the river, which could not be done at the rate above estimated unless the Washington bridge is rebuilt.

This work is under the superintendence of Assistant Engineer H. A. Bentley.

Money statement.

July 1, 1880, amount available	$529 58
July 1, 1881, amount available	529 58

B 7.

IMPROVEMENT OF PROVIDENCE RIVER AND NARRAGANSETT BAY, RHODE ISLAND.

WORK EXECUTED DURING THE FISCAL YEAR ENDING JUNE 30, 1881.

The contractors for excavating under the appropriation of $60,000 made March 3, 1879, and the money left over from the abandoned contract under the appropriation of $50,000 made June, 1878 (the first one made for this work), completed their contract January 1, 1881, having removed 558,227.6 cubic yards of material.

By act of Congress approved June 14, 1880, an appropriation of $60,000 was made for the continuance of this work.

Proposals for excavation were invited, publicly, and on the 14th of August, 1880, the following tenders were received:

No.	Name and address.	Price per cubic yard.	Commence.	Complete.
1	Atlantic Dredging Company, Brooklyn, N. Y.	$0 16¼	Oct. 15, 1880	Sept. 1, 1881.
2	Wm. Flannery, New York	18½	....	
3	Frank Pidgeon, New York	18½	Within 60 days.	Oct. 1, 1881.
4	Jesse and Lyman Boynton, Providence and Boston	19	....	

The Atlantic Dredging Company were again the lowest bidders, and the contract was awarded to them. They began work March 8, 1881, and at this date, June 30, 1881, they are prosecuting it, having removed 253,100 cubic yards.

The work accomplished during the fiscal year has increased the width of channel 23 feet deep at mean low-water across Pawtuxet Shoal from 70 to 200 feet, and the width of the channel 20 feet deep at mean low-water above Field's Point from 200 to 425 feet.

The adjoining sketch shows the locality and extent of the improvement made.

Congress by act approved March 3, 1881, appropriated $60,000 for continuing this improvement.

Advertisements for proposals for excavation under this appropriation were issued, and on the 8th day of June, 1881, the following tenders were received:

Name and address.	Price per cubic yard.
Atlantic Dredging Company, Brooklyn, N. Y.	17 cents for depth of 14 feet at mean low-water, and 19 cents for 12 feet depth.

The contract was awarded to the Atlantic Dredging Company, the only bidders.

BULKHEAD ROCK.

Operations for the removal of this rock to a depth of 20 feet at mean low-water were commenced March 8, 1880, and completed October 14, 1880. The contractor's "plant" consisted of a sloop having a carrying capacity of about 80 tons, and a steam hoisting engine, a drilling frame 26 × 32 feet, a steam drilling apparatus, and the ordinary divers, armor, and air-pump. The crew contained seven men, including the captain and divers.

The extreme length of the rock at 20 feet depth was 120 feet, and its general width about 30 feet, so that the drilling frame had to be moved four times to cover the whole surface of the rock. The superficial area was about 2,900 square feet, and the mean depth to be removed 3¾ feet. The total number of holes drilled was 112, and their total penetration 543 feet, an average of about 4.8 feet for each hole. Two hundred and eighty-two pounds of giant powder were used in blasting these holes.

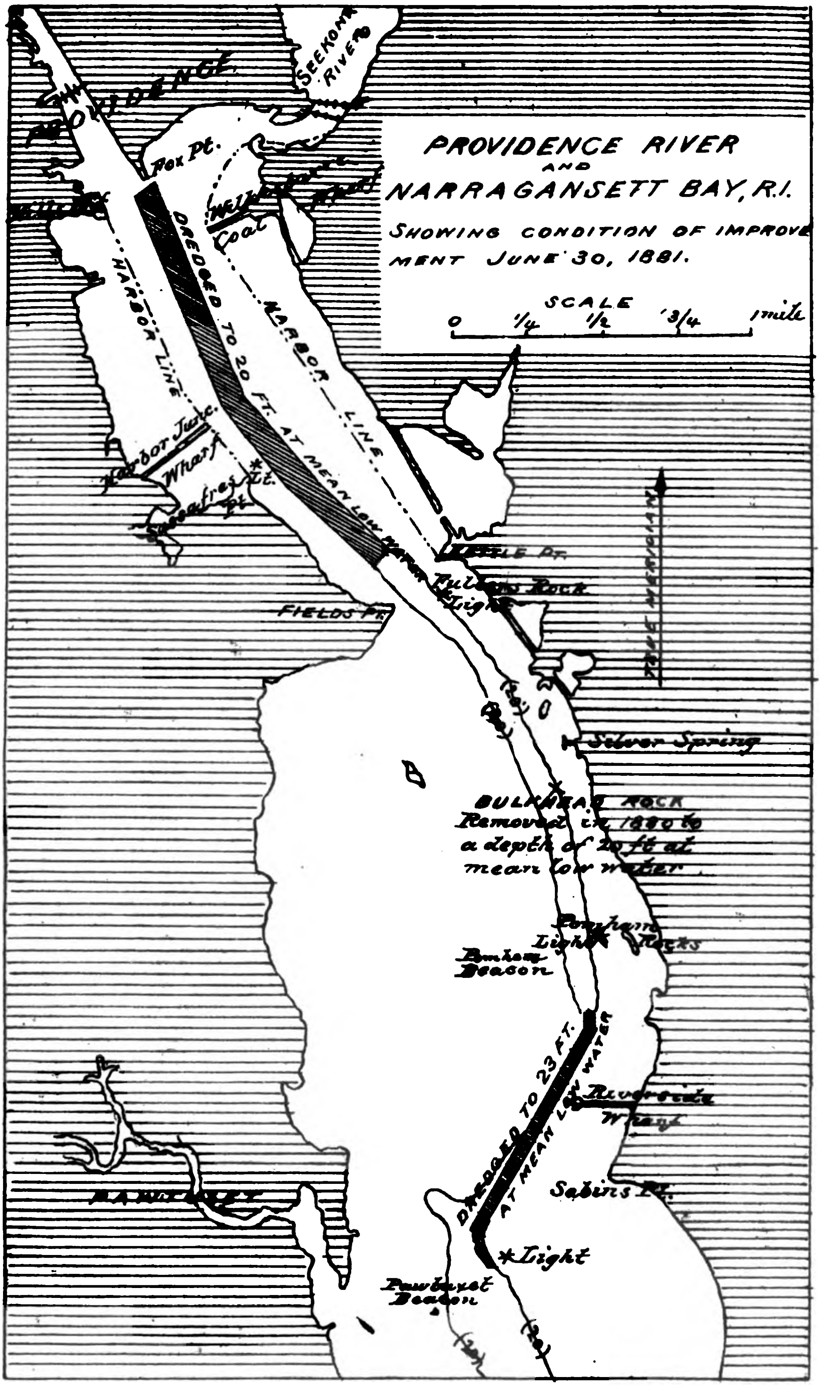
It may be seen from these data that one hole was drilled to each 26.7 feet of superficial area, on which area 2½ pounds of powder were exploded. In addition to this 50 pounds of powder was used in making surface blasts. The large area of rock to each hole drilled and blast made may be accounted for partially by the facts that the rock is of a brittle nature, and the large surface blasts made in 1870 shattered it to a great extent.

There were removed under this contract 794½ tons of rock, which was deposited on the shore east of the work. The explosive material used is known as No. 1, 2, and 3 giant powder.

There is now a depth of 20 feet at mean low-water on this rock; it is even with the surface of the bottom which surrounds it on three sides; on the west or channel side there is a sharp fall of 5 or 6 feet, so that this abrupt face of the rock would confront any vessel of a greater draught than 20 feet, if the vessel should be sailing across the channel. It would not be an obstruction in passing up or down the channel, for the edge of the rock is on the line of channel and does not extend beyond the general contour of 20 feet depth. As the work of improving the main channel progresses and the ultimate depth sought (23 feet at mean low-water) is obtained, it may be found necessary to blast off this edge of the rock, or in some way cover it up so that if a vessel should strike it there would be less danger of serious damage being done.

The improvements in this river have been under the superintendence of Assistant Engineer H. A. Bentley.

The probable operations during fiscal year ending June 30, 1882, will be the continuation of the excavation of a channel 20 feet deep as far as the appropriation of June 14, 1880, will carry it in width. It is pro-



PROVIDENCE RIVER
AND
NARRAGANSETT BAY, R.I.

SHOWING CONDITION OF IMPROVEMENT JUNE 30, 1881.

posed with the appropriation of March 3, 1881, to excavate to depths of 12 and 14 feet at mean low-water and as of great a width as the money will pay for.

The depth to be dredged to was changed from 20 to 12 and 14 feet for the reason that the work contracted for would be sufficient to make the 20-foot channel about 500 feet wide, and although this is not as wide by 100 feet as the original plan contemplated, it is a good navigable channel, and it was deemed best to extend the widths of 12 and 14 feet depth and give smaller vessels a chance to anchor and keep out of the deep channel and away from the large craft; leaving the completion of the 20-foot channel to subsequent appropriations.

One hundred thousand dollars could be judiciously expended in the fiscal year ending June 30, 1883, in widening the channel at Pawtuxet Shoal and increasing the anchorage ground above Field's Point.

Money statement.

Improvement of Providence River and Narragansett Bay.

July 1, 1880, amount available	$103,001 28	
Amount appropriated by act approved March 3, 1881	60,000 00	
		$163,001 28
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	74,330 56	
July 1, 1881, outstanding liabilities	3,258 14	
		77,588 70
July 1, 1881, amount available		85,412 58
Amount (estimated) required for completion of existing project		270,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		100,000,00

Improvement of Providence River—Removal of Bulkhead Rock.

July 1, 1880, amount available	$4,742 13
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,742 13

B 8.

IMPROVEMENT OF POTOWOMUT RIVER, RHODE ISLAND.

A report of the survey under which this improvement was planned is printed as part of House Ex. Doc. No. 18, Forty-sixth Congress, third session.

Three estimates were submitted in the above-mentioned report for channels across the bar at the mouth of the river; two providing for a depth of 6 feet at mean low-water, at a cost of $11,550, and one for a depth of 5 feet, to cost $5,587.50.

Congress, by act approved March 3, 1881, appropriated $5,000 for this work, and as this amount is very near the smallest estimate, the project to make the depth of 5 feet was adopted.

Advertisements for excavation were issued, and on June 8, 1881, the following tenders were received:

No.	Name and address.	Price per cubic yard.	Commence.	Complete.
1	S. A. Hammond, Providence, R. I	$0 23	....	....
2	John McDermott, Cohoes, N. Y	40	....	....
3	J. H. Fenner, Jersey City	59	Mar. 15, 1882	June 30, 1882

The contract was awarded to the lowest bidder, Mr. S. A. Hammond, who is expected to commence the work July 1, 1881.

This improvement is under the superintendence of Assistant Engineer H. A. Bentley.

Money statement.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount expended during fiscal year	48 99
July 1, 1881, amount available	4,951 01

SURVEY OF POTOWOMUT RIVER, RHODE ISLAND.

ENGINEER OFFICE, UNITED STATES ARMY,
Newport, R. I., December 11, 1880.

GENERAL: I forward herewith the report and map of the survey of Potowomut River, Rhode Island, assigned to my charge by you under the law passed at the last session of Congress, and made by Assistant H. A. Bentley.

The survey was asked for for the purpose of making an estimate of the cost of deepening the water to 6 feet at mean low-water over the bar at the mouth, and make the channel 150 feet wide. The present depth is about 2½ feet at mean low-water. The dredged channel would be about 2,500 feet long. There are also a few rocks to be removed.

It is estimated that it will cost $11,550 to make a depth of 6 feet at mean low-water, and $5,587.50 to make a depth of 5 feet. The mean rise of the tide is about 4½ feet. Vessels drawing 11½ feet will be able to pass to "Hope Lands" Landing, about ¾ of a mile above the mouth, when the improvement is made.

The navigation to be benefited is that of vessels bringing ashes and other fertilizers and ice, together with small boats and yachts. The region is a rich agricultural one, without manufactories or through travel.

It is in the Providence collection district, and that place is the nearest port of entry. The amount of revenue collected there for the year ending June 30, 1880, was $405,652.73.

Very respectfully,

G. K. WARREN,
Lieutenant-Colonel Engineers,
Bvt. Maj. Gen., U. S. A.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. H. A. BENTLEY, ASSISTANT ENGINEER.

ENGINEER OFFICE, UNITED STATES ARMY,
Newport, R. I., October 28, 1880.

GENERAL: I have the honor to submit the following report on the survey of the Potowomut River, Rhode Island, authorized by Congress at its last session (see section 2 of river and harbor appropriation act approved June 14, 1880).

DESCRIPTION OF THE RIVER AND LOCALITY.

The Potowomut River is an estuary of Narraganset Bay, situated about 13 miles north-northwest of Newport, and extends in from the west shore of Narraganset Bay a distance of about 3 miles, where its name is changed to Hunt's River. Hunt's River is formed by a number of small streams, all within the limits of Rhode Island; its drainage area is about 40 square miles. Coweset Bay, the entrance to the harbor of Greenwich, is situated about half a mile north of the mouth of the Potowomut, with Sandy Point extending out into Narragansett Bay between the two. The point of land between Greenwich Harbor and Coweset Bay and the Potowomut River is known as Potowomut Neck, a beautiful farming country, protected at its east end by a substantial sea-wall built at private expense.

The other or south side of the river is higher ground, rising abruptly at the river to a height of about 30 feet at Bluff Point, where its greatest elevation is obtained.

* * * * * * *

TIDES.

The mean low-water plane to which the soundings are referred, and the mean rise and fall of tide, were determined by simultaneous observations made here and at Providence.

At the time these observations were made the rise of tide was 4.7 feet at Providence, which is the mean rise and fall lately adopted by us there. The rise at Potowomut River at the same time was 4.5 feet, which is taken and used as the mean rise and fall. Low-water at Providence on the same day was 0.5 foot above mean low-water, and at Potowomut it is assumed that the low-tide bears the same relation to mean low-water as it does at Providence. The correctness of this determination is confirmed by the United States Coast Survey tide-tables, which give the mean rise and fall at Greenwich (3 miles away) as $4\frac{5}{10}$. At Wickford, 7 miles nearer the ocean, the mean rise and fall is $4\frac{2}{10}$ feet. At Newport, near the ocean, it is only $3\frac{9}{10}$ feet.

PROPOSED IMPROVEMENT AND ESTIMATES FOR IT.

It was ascertained by consultation with those interested in this work that a channel with a depth of 6 feet at mean low-water and a width of from 150 to 200 feet across the bar at the mouth of the river, with the removal of Euston's Rocks, was all that was desired or needed.

On the accompanying map two channels, having a width of 150 feet each, have been laid out. The width of 150 feet rather than the one of 200 feet is taken, because it is fully as wide as any part of the channel above, which is large enough for the requirements here. One of the channels is drawn on a straight line connecting the nearest point of the 6-foot contour line outside the bar with the contour having the same depth on the inside. The other proposed channel follows the line of the present channel to the pile of loose stone formerly used as a transfer landing, where it turns and crosses the bar to the nearest portions of the 5 and 6 feet contour lines, outside. If any improvement is to be made here, this latter line is deemed the better, because it is in the line of the greatest tidal flow and would not be so liable to be filled up.

The presence of eel-grass on the inside of the mooring marked on the map indicates that the bottom is not shifting, and that a channel when dredged will not be readily filled up with a new deposit, particularly if it is located in the line of the present tidal flow. Three estimates are submitted. The first is for a channel 150 feet wide and 6 feet deep, on a straight line connecting the deep water on either side of the bar; the second is for the same width and depth of channel, following the present channel to the old landing and thence across the bar; and the third is the same as the second, except that it provides for 5 instead of 6 feet depth.

ESTIMATE FOR CHANNEL 150 FEET WIDE, 6 FEET DEEP AT MEAN LOW-WATER, ON STRAIGHT LINE.

Removal of 50,000 cubic yards mud and sand, at 22½ cents	$11,250
Removal of Euston's Rocks	300
	11,550

ESTIMATE FOR CHANNEL 150 FEET WIDE, 6 FEET DEEP AT MEAN LOW-WATER, FOLLOWING PRESENT CHANNEL TO OLD LANDING.

Removal of 50,000 cubic yards mud and sand, at 22½ cents	$11,250
Removal of Euston's Rocks	300
	11 550

ESTIMATE FOR CHANNEL 150 FEET WIDE, 5 FEET DEEP AT MEAN LOW-WATER, FOLLOWING PRESENT CHANNEL TO OLD LANDING.

Removal of 23,500 cubic yards mud and sand, at 22½ cents	$5,287 50
Removal of Euston's Rocks	300 00
	5,587 50

* * * * * * *

Very respectfully, your obedient servant,

H. A. BENTLEY,
Assistant Engineer.

Bvt. Maj. Gen. G. K. WARREN,
Lieutenant Colonel, Corps of Engineers, U. S. A.

B 9.

IMPROVEMENT OF NEWPORT HARBOR, RHODE ISLAND.

The House of Representatives, on December 6, 1880, passed a resolution asking—

> the Secretary of War for information as to the present condition of Newport Harbor, Rhode Island, and what work is necessary to be done to make the harbor available for the purposes of commerce, with an estimate of the cost of the requisite dredging or other work.

This was referred to me for report by indorsement from your office, dated December 11, 1880.

December 14, 1880, a report was submitted, with a plan for increasing the capacity of the harbor for anchorage, and as a harbor of refuge. It was proposed to dredge the harbor to a depth of 13 feet where the soft material will allow such depth to be made, and to a lesser depth where hard-pan or rock is encountered before reaching 13 feet. This work to be done east of the main channel, through the harbor between the city of Newport and Goat Island, and between Long Wharf and Lime Rock.

The estimated amount of material to be removed is 327,000 cubic yards of mud and sand and a few bowlders; to cost $72,000.

At some future time, for the further increase of anchorage facilities, it may be desirable to deepen the cove east of Fort Adams and remove a portion of the shoal south of Goat Island.

Congress, by act approved March 3, 1881, appropriated $25,000 for this work.

Advertisements for proposals for excavation were issued, and on the 8th of June, 1881, the following tenders were received:

No.	Name and address.	Price per cubic yard.	Commence.	Complete.
1	Henry E. Du Bois, New York City	$0 11		June 30, 1882
2	H. N. and A. J. Beardsley, Bridgeport, Conn	11½		June 30, 1882
3	S. A. Hammond, Providence, R. I	12		June 30, 1882
4	Atlantic Dredging Company, Brooklyn, N. Y	12		June 30, 1882
5	William Flannery, New York City	15		June 30, 1882
6	John McDermott, Cohoes, N. Y	17		June 30, 1882
7	J. H. Fenner, Jersey City, N. J	20	Sept. 1, 1881	June 30, 1882
8	Elijah Brainard, jr., New York City	25	Sept. 1, 1881	June 30, 1882

The contract was awarded to the lowest bidder, Mr. Henry E. Du Bois.

The probable operations during the fiscal year ending June 30, 1882, will be dredging for increased anchorage-ground, to a depth of 13 feet at mean low-water, as far as the available money will allow.

It is probable that $47,000, the remainder of the estimate for this new project, can be profitably expended in the fiscal year ending June 30, 1882.

This improvement has been under the supervision of Assistant Engineer J. P. Cotton.

Money statement.

Amount appropriated by act approved March 3, 1881	$25,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	167 15
July 1, 1881, amount available	24,832 85
Amount (estimated) required for completion of existing project	47,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	47,000 00

B 10.

IMPROVEMENT OF BLOCK ISLAND HARBOR, RHODE ISLAND.

An estimate for increasing the depth at the entrance to and in this basin was called for by a resolution of the House of Representatives in February, 1880. A report with estimate was submitted March 15, 1880, which provided for increasing the depth of the inner harbor and its entrance from 7 to 9 feet at mean low-water, and for the removal of a wreck.

WORK DONE DURING FISCAL YEAR ENDING JUNE 30, 1881.

Congress, by act approved June 14, 1880, appropriated $6,000 for this work.

Advertisement for proposals for dredging was issued July 24, 1880, and on the 14th of August the following proposals were received:

No.	Name and address.	Price per cubic yard.	Commence.	Complete.
1	McDermott & Daly, Cohoes, N. Y	$0 28	Oct. 1, 1880	Dec. 1, 1880
2	Elijah Brainard, jr., New York City	32	Sept. 20, 1880	Dec. 1, 1880
3	William Flannery, New York City	37	....	Dec. 1, 1880

The contract was awarded to the lowest bidders, Messrs. McDermott & Daly, who commenced the work in October and completed it in December, 1880. Sixteen thousand one hundred and forty-six cubic yards of material were removed, making a depth of 9 feet at mean low-water at the entrance to and in the inner harbor or basin.

The wreck lying near the Fall River Iron Company's wharf was removed.

Two boulders, on one of which there was a depth of but 6½ feet at mean low-water, were removed from the outer harbor. These bowlders weighed about 28 tons. The removal of the wreck and bowlders was done by hired labor.

The estimated cost of this improvement was $8,000, but the favorable price at which the dredging was done enabled us to do all that was required with the $6,000, the amount of the appropriation.

There is no immediate demand for an extension of the breakwater, but there undoubtedly will be before long, for the general purposes of coast and ocean navigation.

The present work is designed to furnish the initial point for the work of the future, so that it can be most economically and rapidly constructed when required.

This work has been under the superintendence of Assistant Engineer J. P. Cotton.

Money statement.

July 1, 1880, amount available	$6,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	5,873 74
July 1, 1881, amount available	126 26

B II.

IMPROVEMENT OF LITTLE NARRAGANSETT BAY, RHODE ISLAND AND CONNECTICUT.

Up to the end of the fiscal year, June 30, 1880, there had been expended, in cutting a channel giving 7½ feet deep through the shoals, $19,798.58.

This expenditure was mainly confined to the eastern part, near Pawcatuck Point, where the material was very hard. The channel was made 185 feet wide through this, and for a least width of 40 feet through the other part, which left it still too narrow to be much used by navigators.

WORK EXECUTED DURING THE FISCAL YEAR ENDING JUNE 30, 1881.

On the 14th of August the following tenders for excavating, under the appropriation of June 14, 1880, were received:

No.	Name and address.	Price per cubic yard.	Commence.	Complete.
1	W. H. Beard, Brooklyn, N. Y.	$0 18	Mar. 15, 1881	June 30, 1881
2	McDermott & Daly, Cohoes, N. Y.	22		June 30, 1881
3	William Flannery, New York City	30		June 30, 1881

The contract was awarded to the lowest bidder, who, in April, 1881, applied for an extension of his time of beginning and completion from March 15, 1881, to May 15, 1881, and from June 30, 1881, to July 15, 1881, respectively. This extension was granted.

On the 23d of May the work was commenced, and at the end of the fiscal year the contractor is still engaged on it, having removed 8,092½ cubic yards of material and increased the width of the new channel from 40 feet to 60 feet.

The amount of money expended during fiscal year ending June 30, 1881, is $490.13.

Congress, by act approved March 3, 1881, made an appropriation of $5,000 for continuing this work. Advertisements for proposals for excavation under this appropriation were issued, and on the 8th day of June, 1881, the following tenders were received:

No.	Name and address.	Price per cubic yard.	Commence.	Complete.
1	J. H. Fenner, Jersey City, N. J.	$0 20	Aug. 1, 1881	Oct. 15, 1881
2	John McDermott, Cohoes, N. Y.	22½		

The contract was awarded to Mr. J. H. Fenner, the lowest bidder.

THE PROBABLE OPERATIONS DURING THE YEAR ENDING JUNE 30, 1882.

The channel, 7½ feet deep at mean low-water, will be widened as far as the available money will pay for. It is expected that the work provided for will make a width of about 140 feet, which will give with good ranges a safely navigable channel, and will enable steamboats, and vessels bound for Watch Hill, and the Pawcatuck River, and Westerly, to cross the bay at any stage of the tide. If going up the river, they can then take the full advantage of the tide and the improvements previously made under the general government in the Pawcatuck River.

This improvement is under the superintendence of Assistant Engineer H. A. Bentley.

The amount of money estimated as being necessary to complete the improvement in accordance with the project approved and adopted is $21,000, and this amount could be judiciously expended in the fiscal year ending June 30, 1883.

Money statement.

July 1, 1880, amount available	$5,201 42	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$10,201 42
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		490 13
July 1, 1881, amount available		9,711 29
Amount (estimated) required for completion of existing project		21,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		21,000 00

B 12.

IMPROVEMENT OF CONNECTICUT RIVER, ABOVE HARTFORD, CONNECTICUT, AND BELOW HOLYOKE, MASSACHUSETTS.

In November, 1879, a survey was made of Farmington River Bar, to ascertain the condition of the channel. This survey showed that immediately below the wing-dam built in 1871 the channel divided into three minor channels, with insufficient depth in any one of them. To remedy this it was proposed to build two new wing-dams, one extending down the river about 1,000 feet, and another below from the east bank out to a small island, a distance of about 750 feet.

This project was approved May 5, 1880, and the work was advertised and let June 8, 1880, the Hartford and New York Transportation Company being the contractors, at the price of $1.85 per cubic yard.

The work of delivering stone commenced July 17, 1880, and continued at intervals, when the stage of the river would permit of the work being done, up to June 30, 1881, when it was completed, with the exception of straightening up the work to make it conform to the specifications. This work was paid for from measurement made in the completed dam.

The upper dam has been built a distance of 820 feet from the shore and the lower one 643 feet; this work cost $4,919.70.

This work was under the superintendence of Assistant Engineer Theodore G. Ellis.

Congress, by act approved June 14, 1880, appropriated $15,000 for this improvement.

This amount was too small to undertake the thorough improvement of the river in accordance with the plans heretofore submitted.

A project for the expenditure of $1,000, or as much as might be necessary, for making a careful examination of the proposed route for a canal from Enfield Falls to Hartford, and in revising the former estimates to conform to present prices, was submitted July 22, 1880, and approved July 28. In accordance with this project, the examinations and revisions were made and submitted, under date December 13, 1880, and were printed as House Ex. Doc. No. 25, Forty-sixth Congress, third session. This report is appended.

The revised estimate for the whole work is $1,322,805. As the work will require at least three years to complete it in, not less than $450,000 should be given to start with.

The amount on hand is ample to continue the minor works of alleviation heretofore conducted. (See money statement attached.)

This improvement is under the personal superintendence of Assistant Engineer Theodore G. Ellis.

Money statement.

Above Hartford and below Enfield Falls.

July 1, 1880, amount available		$7,120 04
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$3,000 79	
July 1, 1881, outstanding liabilities	219 78	
		3,220 57
July 1, 1881, amount available		3,899 47

On or above Enfield Falls, Connecticut, and below Holyoke, Massachusetts.

July 1, 1880, amount available	10,702 92
July 1, 1881, amount available	10,702 92

Between Hartford, Connecticut, and Holyoke, Massachusetts.

July 1, 1880, amount available	15,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,330 20
July 1, 1881, amount available	13,669 80
Amount (estimated) required for completion of existing project	1,322,805 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	450,000 00

SPECIAL REPORT.

ENGINEER OFFICE, UNITED STATES ARMY,
Newport, R. I., December 13, 1880.

GENERAL: In the appropriation act approved June 14, 1880, there was an item for improving the Connecticut River, between Hartford and Holyoke, of $15,000, for the expenditure of which I was directed, by instructions from Headquarters Corps of Engineers, dated June 17, to submit a project.

On June 21 I submitted the matter to General T. G. Ellis, the assistant engineer in charge of this work, for his views, it appearing to my mind that the amount was inadequate to accomplish anything desired that was not already provided for.

General Ellis consulted the Hon. George D. Robinson, member of Congress from Springfield, who represents the navigation interests concerned, and the conclusion was reached that before doing anything more there should be a revision of the estimates heretofore made for the canal project between Hartford and the pool above the Enfield Falls, for the purposes of perfecting the location, harmonizing the previous plans, and revising the quantities, and adapting the various items of cost to the conditions of prices of labor and material at the present time. Such a project was submitted to the Chief of Engineers July 22, and approved July 28.

Authority was as soon as possible given to General Ellis to make these revisions, and to make such additional surveys and measurements as he deemed necessary for so doing.

These surveys he began on August 11, and completed them September 17. His report and maps were completed November 13, and are transmitted herewith. The maps, in 3 sheets, are on a scale of 400 feet to an inch.

General Ellis's report is so brief that, as a proper presentation of engineering conditions and requirements, and how to meet them, I may refer the reader to them without attempting more than a brief summary of the matters that are of a general character.

There is now a good navigable depth from Long Island Sound to Hartford of 8 feet at lowest stages of the Connecticut River.

From Hartford up to the Enfield Falls, about 11 miles, there is often no navigation even for vessels drawing 3 feet. The river in this distance flows through alluvial banks, and any project for improving this part so as to obtain the required depth is very expensive and uncertain.

The Enfield Falls extend along the river about 5 miles, and the water descends 33 feet in going this distance, so that over them there is no navigation whatever. Around these falls or rapids is a canal, on the right or west bank, with locks having capacity to pass boats 80 by 19 feet with a draught of 4½ feet. This canal is mainly for furnishing water-power, and is inadequate to any important navigation.

The Enfield Falls are in the State of Connecticut, and no great benefit to improving the navigation of the river can extend into Massachusetts until this obstruction is overcome.

Then, the river is susceptible of 8 feet navigation to Holyoke, 34 miles, above Hartford. There will probably be some outlay to be made between the rapids and Holyoke, not estimated for in General Ellis's report, to secure a draft of 8 feet.

The navigation can eventually be extended further up the valley of the river.

It is required, in submitting reports upon surveys for improvements, to state the importance of the work and the commerce to be benefited, but it is very difficult to do so in this instance. Its main benefit will be to cheapen transportation upon bulky articles, such as coal, iron, and produce, into what is becoming a great manufacturing region, now only reached by railroads. It is probable that the parties interested in the work are much more able to do this than I am, and that they would rather look to it themselves than to have me delay a presentation of the engineering estimates, while it is further attempted here.

The canal estimated for is for navigation only, not for water power. These two objects are incompatible.

The width is fixed at 120 feet at the water line, but all the bridge abutments are to be made to allow a future widening to 150 feet. The draught in the canal is to be 10 feet, to allow the vessels to pass easily along it. There are to be 5 lift-locks placed together at the lower end, and 1 lift and guard lock at the upper end. The locks are to be 200 feet long, 50 feet wide, and 8 feet at low-water, on miter sills.

In submitting these revised estimates, the whole length of the work is divided into 3 nearly equal divisions, corresponding to the 3 map-sheets. Beginning at the lower end, Nos. 1 and 2 extend up to about the foot of the rapids. No 3 extends along the rapids.

Estimate of cost of division No. 1	$669,470
Estimate of cost of division No. 2	268,710
Estimate of cost of division No. 3	384,625
	1,322,805

This work could probably be completed in three years if the money was furnished.

I would recommend that an appropriation of $450,000 be made to start it with.

The amount available now is about $16,900, being a little in excess of the last appropriation, by a remainder from a former one.

The proposed canal is in the Middletown, Conn., collection district, which is a port of entry.

The revenue collected there in the fiscal year ending June 30, 1880, is $51,425.

Very respectfully,

G. K. WARREN,
Lieutenant-Colonel Engineers,
Bvt. Maj. Gen., U. S. A.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. THEODORE G. ELLIS, ASSISTANT ENGINEER.

HARTFORD, CONN., *November*, 13, 1880.

GENERAL: In accordance with authority received August 1, 1880, for making "an examination for the proposed route for a canal from the head of Enfield Falls to Hartford, and a revision of the estimates," such surveys as were necessary were commenced on the 11th of August, and were completed on the 17th of September.

The surveying party consisted of Mr. Charles L. Burdett, assistant engineer, in charge of the field work, Mr. L. H. Gager, leveler, and a party of chainmen, flagmen, &c., composed of Oliver Deming, Charles S. Bunce, James Given, Charles M Ramsey, and John F. Givens.

After the completion of the field examinations, Mr. Burdett and Mr. Gager were retained until about the end of September in plotting and preparing the notes. The maps have been chiefly drawn by Mr. Wendell R. Curtis, assistant engineer.

The original surveys for a canal over this route were made in 1871 and 1872, when the prices for labor and materials were very high, and a high estimate was set upon the value of the land over which the canal would pass. The surveys of 1871 embraced only that part of the route from the head of Enfield Rapids to Warehouse Point, a distance of about 5 miles, and were made at the time with a view only of ascertaining the best route for a canal around the rapids, and not with any idea of a continuation to Hartford. Surveys were made on both sides of the river, embracing all practicable routes, and it was only after a comparison of the advantages and disadvantages of the several plans then proposed that a line upon the east bank of the river was shown to be the best and by far the most practicable.

This canal was intended to be of a depth of 8 feet with 6 feet of water on the miter sills of the locks. The river from below the Enfield Rapids to Hartford would not warrant making a canal of greater depth, as any improvements that might be made in the channel would not be likely to result in obtaining more than 5 or 6 feet of water at the most.

The natural result of the investigation at the rapids was to suggest the continuation of the canal down to some point below the shoal part of the river. Vessels drawing 8 feet or more were running daily to Hartford, and the river above the rapids was capable of improvement to a depth of 8 feet as far as Holyoke. The east side of the river, which had been found to be the best route for a canal around the rapids, presented very favorable ground for the continuation of the canal to a point opposite Hartford, and a spur of high ground near the mouth of the Hockanum River furnished an excellent place for connecting with and entering the Connecticut without crossing the low meadows.

The surveys of 1872 commenced at Warehouse Point and were continued down to the mouth of the Hockanum River. An estimate was made of the cost of a canal between these points, giving it a depth of 10 feet with 8 feet on the miter sills of the locks, with a view to providing for the larger class of vessels which would enter it if commencing at the deep water at Hartford, and a correction was made of the estimate for the part of the canal opposite the rapids above to provide for the required increase in the depth of the canal and locks. This was considered to be sufficient at the time to show the character of the work and its probable cost. A report was made of the Enfield Rapids improvement on January 10, 1872, and a report upon the continuation of the canal to Hartford was made on May 13, 1873, which were printed in the Reports of the Chief of Engineers for the years named. And both were embraced in a general report of the improvements above Hartford, which will be found in the report of the Chief of Engineers for 1878, Appendix B 14, together with maps which show the surveys as then made. These maps are upon a smaller scale than those transmitted with the reports, but illustrate the principal features of the projects.

DESCRIPTION OF THE RIVER.

As a full description of the river above Hartford will be found in the printed reports above referred to, a concise and general description of that part of the river embraced by the canal will only here be given.

The Enfield Rapids extend from Enfield dam a distance of about 5 miles down to opposite the villages of Windsor Locks and Warehouse Point, the fall in this distance being about 33 feet. From the foot of the rapids to Hartford, the slope is less, being about 6.2 feet at low-water, and the river is navigable for boats of light draught.

Around the falls or rapids there is an old canal on the west side of the river, which is furnished with locks of 90 feet in length and 19 feet in width, and has a minimum depth of 4½ feet. This canal is now mostly used for manufacturing purposes, although what navigation there now is above Hartford passes through it. There is at the present time no navigation in the channel over the rapids, although there was formerly an opening in the dam for that purpose.

From Windsor Locks to Hartford, the channel of the river is obstructed with bars, some of the worst of which have been improved by the United States Government during the past eight years, so that there is now about 3 feet depth between Hartford and the foot of the old canal.

Before the government improvements were made, there was about one foot of water only upon some of the bars; the river was then but little used for navigation, but since the improvements, particularly during the past two seasons, there has been a considerable amount of transportation by water to Springfield and Holyoke, Massachusetts, consisting chiefly of coal and other heavy freight.

GENERAL DESCRIPTION OF THE ROUTE.

On the preceding examination of the Enfield Rapids portion of the canal the survey was made of the whole river, embracing both banks, and the canals of the different projects were located on the map and the quantities for the estimates taken from the cross-sections, and other data obtained from the general survey. On this account, and the fact that the two parts of the canal as now proposed were for different depths, it was thought best to run a new line for the canal, so as to take advantage, as far as possible, of the information previously obtained, and note any new features that might present themselves. It was also thought that the route could be improved in some places so as to diminish the amount of work.

It is proposed to take the water at the upper end of the canal from the present level above Enfield dam at its lowest stage. This dam formerly had an opening through the middle, 150 feet wide, which was left for the passage of rafts and such boats as might descend at high-water. At the lowest stages of the water it fell below the top of the dam and passed through this opening, sometimes reducing its level to about a foot below the crest. At the present time, however, this opening is filled with stone nearly or quite up to the level of the crest of the dam, so that the water does not fall to the same level at the lowest stage.

This was particularly observed at Springfield, Mass., during the past extremely dry season, when the water did not reach the lowest point by about 1 foot. The assumed level of the upper end of the canal is taken at 39.20 feet above the Hartford zero, or lowest water at that place. This can be taken without any great alteration of the existing dam or affecting the height of the water in the old canal on the other side of the river.

A lock for the entrance of vessels into the canal at all stages of the water will have to be constructed upon the east bank of the river, and suitable gates provided to supply the canal and maintain it at the proper level. The height of water on the dam in freshets is about 12 feet.

It is proposed to have the entrance gates for the supply of water independent of the lock, as more than the ordinary lock service will be required for the waste in the canal, and the lock sluices cannot be so conveniently regulated.

At the upper end of the canal, for a distance of about 1½ miles, the canal is intended to be partially embanked from the bed of the river, and opposite King's Island about half a mile is to be constructed in the same manner. The high and rocky bank makes this the cheapest construction. The embankment will be carried up to above the height of the highest freshets, and have the sides thoroughly protected with rock. It is intended to make this 2 feet in thickness upon the outside of the embankment, and 1½ feet upon the top and inside.

The bed of the river above and below the dam is to be excavated to obtain the depth of 10 feet as proposed. The depth of this excavation is shown on the profile of the route.

The canal would pass under the east span of the old Enfield bridge, leaving a clear height of about 19 feet above the water. This would be sufficient for boats without masts, and no change would be required in the bridge; but, as it is proposed to make the canal for the passage of all vessels of suitable draught coming to Hartford, provision is made in the estimates for a suitable draw at Enfield bridge.

With the exception of that part of the canal embanked from the river, the line follows the bank just back of the water down to Red Hill, below Warehouse Point. This part presents a large amount of rock cutting, and is the most expensive portion of the route.

Below Red Hill, at Prior's Creek, the line runs further back from the river, along the edge of the high ground, where it meets the meadow level, at a distance of from 2,000 to 4,000 feet from the river bank. This part of the canal can be easily and cheaply built and almost any desired level can be obtained by a careful location, greatly reducing the quantities of excavation and embankment shown by the surveyed line.

The present estimates, however, are based upon the quantities shown by the profile of the line surveyed. Owing to the greater part of the route being upon a side-hill slope, the line can be located so as to balance the cutting and filling with short hauls, and an approximation to such a line is shown by the double red lines upon the map, the actual survey being shown by the red dotted line. A line of survey was run through a hollow, back of Warehouse Point, and also back of Red Hill, to ascertain if an advantage could not be gained by keeping back from the river. A route can be obtained there at about the same cost as the route shown on the map, if it is desired to keep back of the immediate river bank through Warehouse Point. A careful location would be required to show which would be the cheapest. The route along the river is supposed to have some advantages in not cutting off the roads of access to the village, so that it has been adopted in the estimates. At the lower end of the canal it enters the Hockanum River about half a mile from the Connecticut. At this place there is a natural spur so situated that the canal can reach its terminus upon the high ground and drop at once by 3 locks to the river level, without crossing the meadows. The lower end of the Hockanum from the entrance of the canal to the Connecticut River turns nearly southward, and at high-water is protected by the spur before mentioned. This will have to be excavated and straightened so as to form an entrance basin for the canal. It will serve as a safe and protected harbor for vessels awaiting their turn to pass through the canal, and also as a winter harbor for vessels caught in the river when it freezes over in the winter, as they would be protected from the descending ice in the spring.

The mouth of the Hockanum appears to be the only feasible place for the proposed canal to enter the Connecticut River. It is about 1½ miles below the landing at Hartford, but the canal cannot enter directly opposite that place on account of being obliged to cross the meadows for about three-quarters of a mile at right angles to the current which flows over the meadows at high-water. The canal would be submerged in freshets, and be unprotected from the ice, which sweeps down with great force in the spring.

Above Hartford the channel of the river is crossed by two bridges, and is obstructed by bars immediately above the first bridge, making it impracticable to enter at a point higher up.

The mouth of the Hockanum is accessible at all stages of the river, and its banks are wooded and well defined. It is at present navigable up as far as the proposed entrance of the canal, and serves in a limited way as winter harbor for vessels, where they lie safely and protected from ice.

Very few crossings are required on the proposed canal. The route runs generally between the river and the nearest highway, and only requires provision for access to the bridges and ferries, and for such farm crossings as may be necessary to reach the meadow lands cut off by the canal. The principal highways that will be required to be carried over the canal are the road to Enfield Bridge, where a draw will have to be provided, the crossing of the New York, New Haven and Hartford Railroad, the ferry road at Warehouse Point, the main road at Red Hill, the Connecticut River Quarry Company's railway to the river, the road to Bissell's Ferry near the Scantic River, and four roads in East Hartford. These will all require permanent structures with draws, and will be at or near the grade of the tow-path. In addition to these, six farm bridges of a less expensive character will be required. All of these bridges are intended to swing upon a central pier with clear openings of 50 feet on each side.

Few streams of any importance are crossed. The Scantic River is the largest, and the Podunk River is the next in size; the others are smaller and are mere brooks. It is proposed to carry them all under the canal by suitable arches and culverts.

SLOPE AND AMOUNT OF WATER REQUIRED.

In the proposed plan the canal is supposed to be for navigation only. A slope sufficient only for supplying the waste and the amount of lockage is assumed as the most favorable for navigation, as it produces the least amount of current, and the amount of water required to supply the canal and maintain its slope will be a minimum.

The quantity of water required in the canal for the purposes of navigation will be about as follows:

	Cubic feet per second.
For lockage	200
For filtration and leakage	167
For evaporation	3
Total	370

This amount provides for a lockful of water every 10 minutes, a filtration and leakage of 10 cubic feet per second per mile, and an evaporation of .025 of a foot in 24 hours. The quantity lost by filtration and leakage would probably be much more than this for the first year, but after a certain time the deposit of mud upon the banks and bottom of the canal would greatly diminish the loss from this cause.

The slope assumed for the surface of the water in the canal is .00002 of the length. This is about 1¼ inches per mile.

This is a somewhat greater inclination than is required to supply the quantity of water above stated, and allows for all contingencies and obstructions in the bed of the canal. It would give a mean velocity of about 1.19 feet per second in a straight and smooth channel of the section proposed, or a discharge of 1,250 cubic feet per second. In the proposed canal, however, there will be the usual obstructions to the flow of the water resulting from the accidental irregularities of construction, the abutments and piers for the bridges, any constructions which diminish the water-way, and especially the resistance offered by aquatic plants. These, with the small loss of head due to the curves, will probably reduce the mean velocity to about .75 of a foot per second, corresponding to a discharge of 787.5 cubic feet per second.

The slope of the canal has been assumed slightly in excess of the requirements for the purposes of navigation to provide for all contingencies that may arise, and if it should be found that a less amount of water would be desirable, the slope of the water can be allowed to diminish by rising at the lower end and falling at the upper, even to becoming level, without damage to the canal.

The total amount of fall from the upper to the lower end at the proposed inclination is 1.76 feet.

DIMENSIONS OF THE CANAL.

The total length of the canal, from the dam at Enfield to the point where it enters the Hockanum River, is 16.77 miles. From the latter point to the Connecticut River is .53 of a mile, making the whole length 17.30 miles.

In the previous estimates the width of the canal at the water-line was assumed at 150 feet, but this has been reduced in the present estimates to 120 feet, which will be ample for the navigation for some time to come and materially reduces the cost. It is proposed to build all the bridges with the same width between the abutments as before estimated, so that the canal can be widened, if hereafter found desirable. The water in the canal is to be 10 feet in depth, with 8 feet depth on the miter sills of the locks. The slopes of the cuttings and embankments are assumed at 1½ horizontal to 1 vertical. This slope will be somewhat varied in the execution of the work, according to the material met with, but is sufficiently near for the purpose of an estimate.

Upon the embankments the tow-path is intended to be 2 feet above the level of the water and 10 feet wide on top. In the cuttings a berme of 15 feet is allowed at the tow-path on each side of the canal.

This is for the purpose of allowing space for ditches, and for a short space with a flatter slope at the water-line.

The channel in the bed of the Hockanum River, from the foot of the locks to the Connecticut, is intended to be 150 feet wide and to be excavated to a depth of 8½ feet below the lowest water, which gives a depth of 10 feet at the ordinary summer level of the river.

LOCKS.

There is to be 1 lock at the upper end of the canal to admit vessels when the water is above the ordinary summer level. This guard-lock will require to have a lift of 12 feet, and is intended to be 50 feet wide and 200 feet long between the quoins.

In connection with this lock there will be a bulkhead across the upper end of the canal, provided with suitable gates to admit water and regulate the supply to the canal.

At the lower end of the canal there will be a flight of 3 locks, which, by the present survey, can be placed close together in preference to the plan formerly adopted of separating them. This arrangement is preferred as giving a better and more definite entrance to the canal at the highest stages of the river, when one or more of the locks will be submerged.

The locks at the lower end of the canal are to be of the same size and depth as the guard-lock at the dam, viz, 200 by 50 feet, with a depth of 8 feet on the miter-sills. The 2 upper locks are intended to have lifts of 11.5 feet each, and the lower one a lift of 14.44. This is for the purpose of equalizing them at the lower stages of the river. The masonry of the gate-chambers, quoins, miter-sills, and coping is supposed to be of cut granite, with side walls and backing of coursed freestone rubble, all laid in hydraulic cement. The floor of the locks is estimated as being of concrete.

The lock-gates are supposed to be of the ordinary construction, with white-oak timbers and pine sheathing, and to be opened and shut by capstans. The supply of water being ample, the gates can be easily arranged to be operated by means of turbines without much additional expense.

ARCHES AND CULVERTS.

At the following places arches will be required to carry the streams under the embankment, viz:

At Scantic River, two 20-foot arches.
At Podunk River, one 10-foot arch.
At Stoughton's Brook, one 10-foot arch.
At Boyle's Brook, one 10-foot arch.
At Prior's Creek, one 6-foot arch.
At Red Hill Brook, one 6-foot arch.

The smaller streams are intended to be carried under the embankment by box culverts of from 2½ to 5 feet in width.

The arches are to have the abutments, wings, and backing of coursed freestone rubble with cut freestone corners, coping, and arch courses. The box culverts are to be of coursed freestone rubble with granite covers.

All of the foregoing masonry is to be laid in hydraulic cement.

BRIDGES.

It is proposed to make the faces of the abutments of the bridges in line with the edges of the surface of the water in the canal, or 120 feet apart, and to place a circular pier in the middle of the water-way, so as to provide for a swing bridge of at least 50 feet clear opening on each side of the central pier. The abutments and piers are intended to be of coursed rubble with cut corners, coping, and bridge seats, all of freestone.

The bridges are intended to be of iron. Those for the main roads to be 20 feet wide and those for the farm crossings 10 feet wide and correspondingly lighter.

WASTE-WEIRS AND RETAINING-WALLS.

The masonry of the waste-weirs is to be of coursed rubble with cut corners and coping similar to that described for the bridge abutments.

The retaining-walls at the ends of the locks and other places where necessary are to be built of rubble masonry laid in hydraulic cement.

MATERIALS.

From the upper end of the canal to the Scantic River, the earth to be excavated consists mostly of a clayey loam. Beneath this, from Enfield dam to Red Hill, just below Warehouse Point, is rock, for which an ample allowance is made in the estimates. Below Scantic River the material becomes more sandy, and for a long distance at the lower end of the canal it is almost a pure sand.

It is proposed to make the embankments entirely of the material excavated, and to build them up in layers, slightly concave, and well compacted by the teaming over them, in preference to making puddled walls in the interior, even where the material is entirely sand. The expedient of constructing a puddled wall in a dam or embankment is very expensive, and experience has shown it to be of extremely doubtful value; and it is believed that the best modern engineering practice is to make the whole embankment of uniform material, properly brought up in consecutive layers. Canals formed in very porous material, like coarse gravel, soon become tight from the deposit of silt from the water. The waste that would occur from filtration during the first few years in a canal constructed as proposed, would be of little importance, as there would be an ample supply of water and a sufficient slope to maintain the proper depth of water.

A suitable red sandstone for the rubble masonry can be obtained in the vicinity of the work. The cut blocks for the corners and coping, and for the arches, can be obtained from the quarries at East Windsor, where large blocks of excellent quality can be procured. This stone can also be obtained at the Portland quarries, near Middletown, Conn., and transported by water to near where it will be required for use.

The granite used in the locks, it is thought, can be procured of suitable quality from the quarries near the mouth of the Connecticut River.

There is also excellent granite at Westerly, R. I., and at Leet's Island, Conn., where large and fine blocks can be quarried.

The timber for the lock-gates, &c., can be best procured from Vermont and New Hampshire, and brought down by railroad to where it is to be used.

The iron work for the bridges and locks would probably be furnished by some of the large contracting companies which furnish bridges and similar constructions. It could be procured at Springfield or Hartford, where there are suitable works for its manufacture.

ESTIMATES.

For convenience in making the estimates, the whole route has been divided into three divisions, embracing about one-third of the whole length in each. These divisions are shown on the three sheets of the accompanying map.

ESTIMATE, DIVISION NO. 1.

448,000 cubic yards earth excavation, at 15 cents	$67,200
98,000 cubic yards excavation in Hockanum River, at 25 cents	24,500
7,900 cubic yards excavation for foundations, at 40 cents	3,160
2,500 cubic yards clay puddling, at $1	2,500
9,470 cubic yards rubble masonry in locks, at $8	75,960
2,100 cubic yards cut stone in locks, at $14	29,400
1,660 cubic yards rubble in arch abutments, at $6	9,960
810 cubic yards arch masonry, at $12	9,720
40 cubic yards cut stone in arch abutments, at $10	400
1,560 cubic yards rubble in bridge abutments, at $6	9,360
160 cubic yards cut stone in bridge abutments, at $10	1,600
200 cubic yards rubble masonry in waste weirs, at $6	1,200
40 cubic yards cut stone in waste weirs, at $10	400
620 cubic yards culvert masonry, at $5	3,100
2,700 cubic yards concrete, at $3	8,100
4 pairs of lock-gates	12,000
3 waste weirs	1,000
4 Swing road-bridges, superstructure	20,000
3 swing farm-bridges, superstructure	9,000
Coffer-dams, &c	4,000
Land damages, 5.73 miles, at $10,000	57,300
Engineering and contingencies, 10 per cent	34,966
Total	384,626

ESTIMATE, DIVISION NO. 2.

735,000 cubic yards earth excavation, at 15 cents	110,250
7,600 cubic yards excavation for foundations, at 40 cents	3,040
2,660 cubic yards rubble in arch abutments, at $6	15,960
1,620 cubic yards arch masonry, at $12	19,440
80 cubic yards cut stone in arch abutments, at $10	800
1,050 cubic yards rubble in bridge abutments, at $6	6,300
110 cubic yards cut stone in bridge abutments, at $10	1,100
2,120 cubic yards culvert masonry, at $5	10,600
2 swing road-bridges, superstructure	10,100
3 swing farm-bridges, superstructure	9,000

Coffer-dams, &c	$1,000
Land damages, 5.68 miles, at $10,000	56,800
Engineering and contingencies, 10 per cent	24,429
Total	268,719

ESTIMATE, DIVISION NO. 3.

468,600	cubic yards earth excavation, at 20 cents	93,720
150,000	cubic yards rock excavation, at $1	150,000
61,000	cubic yards rock bottom excavation, at $2	122,000
3,400	cubic yards excavation for foundation, at 40 cents	1,360
16,300	cubic yards rock in channel above dam, at $4	65,200
1,200	cubic yards clay puddling, at $1	1,200
3,160	cubic yards rubble masonry in guard lock, at $8	25,280
730	cubic yards cut stone in guard lock, at $14	10,220
350	cubic yards rubble in arch abutments, at $6	2,100
120	cubic yards arch masonry, at $12	1,440
10	cubic yards cut stone in arch abutments, at $10	100
780	cubic yards rubble in bridge abutments, at $6	4,680
75	cubic yards cut stone in bridge abutments, at $10	750
600	cubic yards rubble in railroad-bridge abutments, at $6	3,600
200	cubic yards cut stone in railroad bridge abutments, at $10	2,000
350	cubic yards rubble masonry in gate head, at $6	2,100
100	cubic yards cut stone in gate head, at $14	1,400
150	cubic yards rubble masonry in 2 waste weirs, at $6	900
30	cubic yards cut stone in 2 waste weirs, at $10	300
1,020	cubic yards culvert masonry, at $5	5.100
2,900	cubic yards retaining walls, at $4	11,600
900	cubic yards concrete, at $3	2,700
1	swing-bridge for railroad, superstructure	8,000
3	swing road-bridges, superstructure	15,000
2	pairs of lock-gates	6,000
2	waste weirs	700
	Gates at entrance to canal	1,500
	Gate house	750
	Alteration of dam at Enfield	5,000
	Coffer-dam, &c	5,000
	Land damages, 5.89 miles, at $10,000	58,900
	Engineering and contingencies, 10 per cent	60,860
	Total	669,460

SUMMARY OF TOTAL COST OF CANAL.

Division No. 1	384,626
Division No. 2	268,719
Division No. 3	669,460
Total	1,322,805

LIST OF BENCH-MARKS USED ON THE SURVEY.

The base for the heights of the bench-marks is low-water mark at Hartford, or zero of the gauges at the toll bridge and at the steamboat wharf.

Top of freestone foundation at the northeast corner of house on the southwest corner of Wawarme avenue and Van Dyke avenue, Hartford	31.540
Cut on east side of an ash tree near the mouth of the Hockanum River, west bank, 400 feet from the Connecticut River and 100 feet from the Hockanum River	14.733
Cut on west side of an elm tree near the northwest corner of Deming's collar shop, in East Hartford	32.613
Cut on maple tree 1,270 feet west of southwest corner of a road to the meadows, said corner being about 2,650 feet north of Podunk River Bridge on main road in South Windsor	34.055
Cut on south side of maple tree, 520 feet west of the main road and 1,230 feet south of Stoughton's Brook, in John Moore's lot, South Windsor	23.344
Cut on south side of hickory tree, 210 feet northwest of the northwest corner of tobacco shed in Charles Wells's lot, East Windsor	50.704
Cut on the northwest side of a large hickory tree, about 900 feet northeast of the mouth and 100 feet west of Prior's Creek, East Windsor	27.152

Northeast corner of underpinning stone at the northeast corner of red tobacco shed belonging to J. C. Bassinger, on the west side of river road at Warehouse Point	29.810
Top of south west corner of abutment of New York, New Haven and Hartford Railroad Bridge at Warehouse Point	62.900
Top of northeast corner of north end of capping to east wall of brick arch bridge, over second road south of Thompsonville Station on New York, New Haven and Hartford Railroad, being about 300 feet south of the southwest corner of said station	76.663

MAPS ACCOMPANYING THIS REPORT.

Accompanying this report is a map on 3 sheets showing what is considered the most feasible location for the canal. It has been prepared from recent surveys and examinations together with the latest surveys of the river above Hartford. This map is upon a large scale, 400 feet to an inch, and contains a profile of the route as actually surveyed. Reference is also made to sheets 1, 2 and 3, of the report of the surveys above Hartford, printed in the Report of the Chief of Engineers for 1878, upon a reduced scale, Appendix B 14, "Warren and Ellis's Reports on the Connecticut River above Hartford," plates I and II. These reduced sheets show generally the route of the canal, being marked "proposed canal," and "No. 2," on sheet 3, and is the only route shown on sheets 1 and 2.

All of which is respectfully submitted.

THEO G. ELLIS,
Civil Engineer.

General G. K. WARREN,
Lieutenant-Colonel of Engineers, U. S. A.

B 13.

IMPROVEMENT OF CONNECTICUT RIVER BELOW HARTFORD, CONNECTICUT.

WORK EXECUTED DURING FISCAL YEAR ENDING JUNE 30, 1881.

Congress, by act approved June 14, 1880, appropriated $10,000 for the improvement of the Connecticut River, Connecticut, below Hartford.

Under this appropriation and about $8,900 available from the appropriation of March 3, 1879, advertisements were issued on approved projects August 14, 1880, for riprap for the jetties at Saybrook and for dredging the temporary channels through the shoals at low-water between Rocky Hill and Hartford. The proposals were as follows:

Abstract of proposals for furnishing riprap granite for jetties at mouth of Connecticut River, Connecticut, opened August 14, 1880.

No.	Name and address.	Price per gross ton.	Commence.	Complete.	6,000 tons would cost.
1	John Beattie, Leetes Island, Conn	$1 05	....	Dec. 1, 1880	$6,300
2	James Scully, Groton, Conn	1 10	....	Dec. 1, 1880.	6,600
3	Fred'k K. Ballou, Boston, Mass	1 24½	....	Dec. 1. 1880.	7,470

The contract was awarded to the lowest bidder, Mr. John Beattie, at $1.05 per ton of 2,240 pounds.

Abstract of proposals for excavation in Connecticut River between Hartford and Middletown, opened August 14, 1880.

No.	Name and address.	Price per cubic yard.	Commence.	Complete.
1	McDermott & Daly, Cohoes, N. Y	$0 15¾	Aug. 24, 1880	Oct. 31, 1880
2	Hartford and New York Steamboat Company, Hartford.	15⅞	Aug. 16, 1880	Oct. 31, 1880
3	William Flannery, New York City	16	... ...	Oct. 31, 1880
4	S. A. Hammond, Bridgeport, Conn	20	Sept. 15, 1880	June 30, 1881

The contract was awarded to the lowest bidders, Messrs. McDermott & Daly, at 15¾ cents per cubic yard.

The work of dredging was commenced August 25, 1880, at Glastonbury Bar, from which bar 11,130 cubic yards were dredged, making a channel 50 feet wide and 9½ feet deep. There was but 6 feet depth before the dredging was done.

The dredge was then removed to Hartford Bar, where a channel of the same width and depth was made by the removal of 4,800 cubic yards of material. This completed the work contracted for.

Several stumps, pieces of stone, and trees, either in the channel or in dangerous proximity to it, were found during last season. These were removed, at a cost of $300 by Capt. T. A. Scott, under special arrangement authorized by the Engineer Department.

The contractor for furnishing stone for the jetties at the mouth of the river commenced September 13 and completed his contract in January, 1881.

Six thousand one hundred and eighty-four and thirty-seven one-hundredths tons of stone rock delivered, which was principally put on the east jetty, building it up where it was too low and extending it 161 feet. A small amount of stone was placed on the west jetty to build it up at low parts.

On the 5th of April, 1881, advertisements were issued for proposals for dredging the troublesome bars which the low-water of that spring should discover. On the 20th of April the following bids were received:

No.	Name and address.	Price per cubic yard.	Commence.	Complete.
1	Ezra H. Williams, president Hartford Dredging Company, Hartford.	$0 13	May 1, 1881	July 31, 1881
2	Hartford and New York Steamboat Company, Hartford.	13⅝	May 1, 1881	July 31, 1881
3	Edgar M. Payn, Albany, N. Y	16⅞	May 1, 1881	July 31, 1881
4	John McDermott, Cohoes, N. Y	18	May 1, 1881	July 31, 1881

The contract was awarded to Ezra H. Williams, president Hartford Dredging Company, the lowest bidder, at the price of 13 cents per cubic yard.

This work was commenced May 31, 1881, at Glastonbury Bar. Up to June 30, 10,132 cubic yards were removed, making a channel 2,850 feet long, 25 feet wide, and 9½ feet deep at low-water.

Congress, by act approved March 3, 1881, appropriated $30,000 with the following provisions:

> Ten thousand dollars shall be used to continue the work in progress at the bar at the mouth of the river, and three thousand dollars in dredging the channel below Rocky Hill.

The project of March 24, 1881, for the expenditure of this money was approved and provided:

First. For from $3,000 to $6,000 to be spent in dredging at the next low-water between Hartford and Rocky Hill, to give a navigable depth of 9 feet at low-water.

Second. To build a wing-dam at Glastonbury Bar as far as $12,000 would pay for. This dam to form a part of the permanent plan of improvement, submitted February 14, 1880.

Third. For dredging below Rocky Hill, $3,000.

No dredging being required in this section, except on Saybrook Bar, and the scouring effect produced by the jetties having apparently about reached its limit because of the hard material, it was proposed to expend this $3,000, and as much of the $10,000 set apart for Saybrook Bar as should be necessary, to determine by dredging whether the scouring effect will maintain the increased depth so made.

Fourth. The Saybrook jetties, probably 2 feet increase has been secured by the scouring effect already, so that there is now 8 feet depth at low-water, which accommodates all the vessels that can reach Hartford. But a greater depth can be carried as far as Middletown, and the future improvements contemplate a greater depth to Hartford, so that on this account we should have a greater depth at Saybrook Bar. Again, there is anchorage inside for the largest coasters if they could cross the bar, and all the depth that can be secured is desirable for the object of making this place a harbor of refuge.

The jetties have been built sufficiently to prove their useful effect, and steps must be taken soon for better marking, and for lights or beacons. But before planning these as permanent works, it is best to have the effect of dredging determined, so that we can plan according to the importance of the entrance. Temporary work is therefore proposed and piles will be driven at the ends of the jetties, and temporary beacons established, as experience shows the necessity for. The jetties will be built up at places of settlement, and the height raised at intervals, with riprap granite, to better define their line at night.

In accordance with the above plan advertisements were issued May 11, 1881, for proposals for building a wing-dam at Glastonbury Bar, and for furnishing riprap granite for jetties at Saybrook Bar, the following were received.

This work has been under the superintendence of Assistant Engineer Theodore G. Ellis.

Abstract of proposals for building a wing-dam at Glastonbury Bar, received June 8, 1881.

No.	Name and address.	Price per cubic yard.	Commence.	Complete.
1	Ezra H. Williams, Hartford, Conn.	$3.60 if built of brush and stone; $1.60 if built of stone alone.	....	Dec. 1, 1881

The proposition of Mr. Ezra H. Williams to build the dam entirely of stone for $1.60 per cubic yard was accepted, and the contract awarded to him.

Abstract of proposals for furnishing riprap granite for jetties at Saybrook Bar, received June 8, 1881.

No.	Name and address.	Price per ton of 2,240 pounds.	Commence.	Complete.
1	John Beattie, Leetes Island, Conn	$1 29	....	Dec. 1, 1881

The contract was awarded to Mr. John Beattie, the only bidder, at $1.29 per gross ton.

PROBABLE OPERATIONS DURING FISCAL YEAR ENDING JUNE 30, 1882.

Dredging between Hartford and Rock Hill will be continued during the low-water of this season until a depth of 9 feet at low-water is secured on the bad bars.

In the early part of the year 1882 dredging will probably be required again, which will be done under a new contract with the funds reserved from the last appropriation.

The work of building a wing-dam at Glastonbury Bar will be commenced and finished as nearly as the means will allow.

At the jetties at Saybrook stone will be placed as required, and the efficacy of dredging between the jetties tested.

Piles will be driven at the ends of the jetties, if necessary, and temporary lights provided.

The entire and permanent completion of the improvement of the river between Hartford and Middletown it is estimated will cost $330,000.

Twelve thousand dollars of the last appropriation will be used in the permanent improvement; this leaves $318,000 necessary to complete the projected improvement.

One hundred and three thousand dollars could be judiciously expended during the fiscal year ending June 30, 1883, on the Glastonbury division of this work and upon the bar at Saybrook.

The permanent completion of the jetties cannot be estimated for until the importance of the entrance can be determined.

These works are under the special charge of Assistant Engineer Theodore G. Ellis.

An appropriation of $6,000 will be required to keep the channel of 9 feet depth open to Hartford.

The total estimate for the year ending June 30, 1883, is $109,000.

Money statement.

July 1, 1880, amount available	$18,318 66	
Amount appropriated by act approved March 3, 1881	30,000 00	
		$48,318 66
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		12,622 62
July 1, 1881, amount available		35,696 04
Amount (estimated) required for completion of existing project		318,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		109,000 00

APPENDIX C.

IMPROVEMENT OF HARBORS AND RIVERS ON LONG ISLAND SOUND.

REPORT OF MAJOR J. W. BARLOW, CORPS OF ENGINEERS, BVT. LIEUT. COL., U. S. A., OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1881, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

ENGINEER OFFICE, UNITED STATES ARMY,
New London, Conn., July 28, 1881.

GENERAL: I have the honor to transmit herewith the annual reports upon the river and harbor improvements in my charge for the fiscal year ending June 30, 1881.

Much difficulty and delay have attended the procurement of the commercial statistics required by department circular of December 9, 1880. The results obtained are believed to be approximately correct, though not in all cases as complete as was desired.

I am, general, very respectfully, your obedient servant,

J. W. BARLOW,
Major of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

C 1.

IMPROVEMENT OF STONINGTON HARBOR, CONNECTICUT.

At the close of the fiscal year ending June 30, 1880, work upon the west breakwater was in progress under an uncompleted contract with Frederick K. Ballou, of Boston, Mass. During the fiscal year ending June 30, 1881, 9,113 tons of riprap granite were delivered by the contractor, completing the work. The breakwater was finished at each end, with a cut-stone pier-head; is 2,025 feet long; and contains 94,158 tons of granite. It cost $103,190, an average of $1.09½ per ton, or about $51 per linear foot.

By act of Congress approved June 14, 1880, $25,000 was appropriated for continuing the improvement of this harbor. At the time of making the last annual report it was believed that a portion of this appropriation would be required to complete the west breakwater. The amount proved to be quite small, only $690 of that appropriation being needed to finish the work.

In accordance with the wishes of the citizens of Stonington, and of those interested in obtaining the appropriation, the project submitted for the expenditure of the money recommended that a survey be made with a view of determining a site for an east breakwater to cut off the ocean swell, which in times of east and southeast gales makes in between Napatree Point and the east end of Fisher's Island. Such a breakwater would also provide a safe anchorage for the large fleet of coasters continually passing through Fisher's Island Sound. By direction of the Chief of Engineers, the survey was made in August, 1880, covering the area bounded by Bartlett's Reef and Stonington Point on the east and by the west breakwater and the Middle Ground on the west. The matter of the further improvement of the harbor was referred to the Board of Engineers for Fortifications and for River and Harbor Works, whose report is appended.

In accordance with the recommendation of the Board, the Chief of Engineers authorized the commencement of a work to be built upon a line extending from the south end of Bartlett's Reef to the north end of the Middle Ground. Proposals were invited for the delivery of riprap granite, and bids were opened November 10, 1880. Frederick K. Ballou, of Boston, Mass., the lowest bidder, was awarded the contract, at the rate of 88 cents per ton. The first load of stone was delivered December 11, 1880, at a point about midway between the south end of the reef and the north end of the Middle Ground. Work was continued through the winter and spring in an easterly direction, and on June 16, 1881, the contract was completed. Under this contract 24,750 tons of stone were delivered, making 500 feet of completed breakwater.

By act of Congress approved March 3, 1881, $30,000 was appropriated for the further improvement of this harbor. With this sum it is proposed to continue the construction of the breakwater, extending it in an easterly direction sufficiently far to prevent the ocean swell now passing to the east of the work from entering the harbor. In accordance with this project proposals were invited for the delivery of riprap granite. The bids were opened June 15, 1881, and the contract awarded to Frederick K. Ballou, of Boston, Mass., the lowest bidder, at the rate of $1.14½ per ton. Work under this contract was commenced June 21, and at the close of the fiscal year 1,641 tons of granite had been delivered.

The improvement of Stonington Harbor by the general government began in 1828–'30 with the construction of a pier from the shore on the east side of the harbor, at a cost of $36,753.83.

In 1871 a survey was made with a view to further improvements. In 1873 and 1874 appropriations were made amounting to $45,000. This amount was expended in dredging to a depth of 12 feet at mean low-water over the area north of the pier and of the northern part of Penguin Shoal, resulting in the removal of 209,509 cubic yards of material. In 1875 the construction of the breakwater lying southeast of Wamphassuck Point was commenced in accordance with the recommendation of a board of Engineers. The cost of this work has been reported upon in a preceding paragraph.

The following amounts have been appropriated for the improvement of Stonington Harbor, since 1871.

March 3, 1871	$1,166 00
March 3, 1873	25,000 00
June 23, 1874	20,000 00
March 3, 1875	25,000 00
June 18, 1878	40,000 00
March 3, 1879	37,500 00
June 14, 1880	25,000 00
March 3, 1881	30,000 00

Stonington is the port of entry for the Stonington collection district. There is a light-house on Stonington Point and a light-ship 2 miles southwest of Wamphassuck Point. Fort Trumbull, the nearest work of defense, is 12 miles distant.

Money statement.

July 1, 1880, amount available	$33,552 18	
Amount appropriated by act approved March 3, 1881	30,000 00	
		$63,552 18
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		33,525 86
July 1, 1881, amount available		30,026 32
Amount (estimated) required for completion of existing project		45.000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		45,000 00

Abstract of proposals opened November 10, 1880, for improvement of Stonington Harbor, Connecticut; construction of breakwater.

No.	Name and address of bidder.	Will commence.	Will complete.	Price per ton of 2,240 pounds.	Tons of stone appropriation will furnish.
1	Alex. J. Howell, New York City	Nov. 15, 1880	June 30, 1881	(*)	
2	F. K. Ballou, Boston, Mass	Nov. 15, 1880	June 30, 1881	$0 88	25,568
3	John Beattie, Leete's Island, Connecticut	Nov. 15, 1880	June 30, 1881	1 02½	21,951
4	Arnold & Stephens, Oneida, N. Y	Nov. 15, 1880	June 30, 1881	1 18¾	18,947

* Bid informal. No amount given in bond. Price bid, $1.07 per yard.

Abstract of proposals opened June 15, 1881, for improvement of Stonington Harbor, Connecticut; construction of breakwater.

No.	Name and address of bidder.	Will complete.	Price per ton of 2,240 pounds.	Tons of stone appropriation will furnish.
1	F. K. Ballou, Boston, Mass	June 30, 1882	$1 14½	23,588
2	Joseph H. White, Hyde Park, Mass	June 30, 1882	1 33	20,300
3	Charles H. Edwards, Quincy, Mass	June 30, 1882	1 27	21,260
4	John Beattie, Leete's Island, Connecticut	June 30, 1882	1 25	21,500

Abstract of contract for the improvement of Stonington Harbor, Connecticut, in force during the fiscal year ending June 30, 1881.

No.	Name and address of contractor.	Date of contract.	Subject of contract.	Price per ton.	Remarks.
1	F. K. Ballou, Boston, Mass	Nov. 15, 1880	Riprap granite	$0 88	Contract completed June 16, 1881.
2	F. K. Ballou, Boston, Mass	June 21, 1881	Riprap granite	1 14½	

COMMERCIAL STATISTICS.

Approximate amount of materials received in and shipped from Stonington Harbor, Connecticut, for the 10 *years ending June* 30, 1880.

	Year ending June 30.									
	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.
Received:										
Coal ....tons	50,000	50,000	50,000	50,000	50,000	55,000	57,000	58,000	57,000	59,000
Iron ....tons	1,747	1,615	1,120	100	75	87	100	125	175	250
Lumber ....1,000 feet	2,500	2,600	2,600	2,800	3,000	3,000	2,700	2,900	3,000	3,000
General merchandise, tons	73,910	85,830	91,765	90,852	101,704	101,420	111,550	121,225	141,745	151,560
Shipped:										
Coal ....tons	35,000	35,000	35,000	35,000	35,000	37,000	38,000	40,000	40,000	40,000
General merchandise tons	86,610	94,520	106,510	106,675	108,870	120,975	120,940	130,770	150,635	160,650
Vessels arriving and departing:										
Steamers	1,274	1,299	1,304	1,314	1,274	1,305	1,340	1,380	1,528	1,584
Sailing vessels	900	950	975	980	1,000	1,100	1,150	1,200	1,300	1,350
Barges..................	30	40	35	50	50	55	60	65	65	70

The above figures include the freights and trips of the Stonington Steamship Company between Stonington and New York.

Number of vessels which have passed by or in the vicinity of Eel Grass Shoal Light-Vessel from January 1, 1874, *to December* 31, 1880.

[Eel Grass Shoal is in Fisher's Island Sound, about 3 miles west southwest from Stonington light-house.]

Year.	Ships.	Barks.	Brigs.	Schooners.	Sloops.	Steamers.	Totals.
1874	10	36	260	17,715	4,386	3,819	26,226
1875	5	22	124	15,472	4,205	3,425	23,253
1876	11	19	71	13,308	4,781	3,571	21,761
1877	18	28	45	14,729	5,010	3,407	23,237
1878	10	23	75	11,108	4,646	3,609	19,471
1879	7	26	81	14,323	4,522	4,920	23,879
1880	18	47	66	13,786	3,199	4,507	21,623
Whole number	....	....	....	....	....	....	159,450

Chas. E. P. Noyes,
Keeper.

COLLECTIONS AT THE PORT OF STONINGTON DURING THE FISCAL YEAR ENDING JUNE 30, 1881.

Duties on imports	$239 87
Tonnage dues	24 60
Hospital tax	774 96
Miscellaneous receipts	1,472 26
Total	2,511 69

Number of foreign vessels arrived from foreign ports	4
Number of foreign vessels cleared for foreign ports	4
Number of American vessels arrived from foreign ports	
Number of American vessels cleared for foreign ports	1
Number of vessels of all classes entered and cleared during the year	730
Total tonnage	1,382,040
Estimated value of cargoes received	$24,650,740
Estimated value of cargoes shipped	$26,580,620
Number of vessels of all classes entering the harbor for refuge during the year	1,720

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., October 13, 1880.

SIR: The river and harbor act of June 14, 1880, appropriates $25,000 for improving Stonington Harbor, Connecticut. It is anticipated that a small part only of the appropriation will be needed to complete the west breakwater now in course of construction at this harbor, and as a large balance will remain available for further improvement of the harbor, before taking steps towards the application of this balance the Chief of Engineers referred the subject of this improvement to the Board of Engineers for Fortifications and River and Harbor Improvements to report what additional work, if any, is required or necessary for the further improvement of the harbor.

The report of the Board thereon is herewith respectfully submitted.

It will be perceived that to effectually screen the harbor against southeasterly storms and at the same time to furnish a refuge for coastwise fleets, the Board recommends the construction of an additional breakwater at a cost of about $100,000, and designates its location and extent.

The views and conclusions of the Board are approved by this office, and as the importance of Stonington Harbor as a harbor of refuge is conceded, and it is believed that those who were instrumental in procuring this appropriation had the construction of this additional breakwater in view, I beg leave to recommend that the officer of engineers in charge of the improvement of the harbor be instructed to proceed with the commencement of this work in accordance with the views of the Board.

Very respectfully, your obedient servant,

H. G. WRIGHT,
Chief of Engineers,
Brig. and Bvt. Maj. Gen.

Hon. ALEXANDER RAMSEY,
Secretary of War.

[Indorsement.]

Recommendation of the Chief of Engineers approved.

By order of the Secretary of War.

H. T. CROSBY,
Chief Clerk.

WAR DEPARTMENT, *October* 15, 1880.

REPORT OF THE BOARD OF ENGINEERS.

OFFICE OF THE BOARD OF ENGINEERS FOR FORTIFICATIONS
AND FOR RIVER AND HARBOR IMPROVEMENTS, &c.,
New York, August 24, 1880.

GENERAL: The Board of Engineers for Fortifications and for River and Harbor Improvements, in reply to your letter of July 3, 1880, which is as follows:

> OFFICE OF THE CHIEF OF ENGINEERS,
> UNITED STATES ARMY.
> *Washington, D. C., July* 3, 1880.
>
> SIR: The river and harbor act approved June 14, 1880, contains the following item: "Improving Stonington Harbor, Connecticut, twenty-five thousand dollars."

On a call from this office for project of application of this appropriation, Major Barlow submits the following:

"It is proposed to make a survey of the harbor with a view to submitting plans for an easterly breakwater, it being understood that this is the project specially desired by those interested in the improvement of this harbor.

"It is anticipated that a small part of the appropriation will be needed to complete the west breakwater, an estimate for which will be presented as soon as the exact amount is definitely known."

From this it appears that after the completion of the present breakwater a large balance will remain of the above appropriation available for further improvement of the harbor, but before taking any steps towards the application of this balance, the Chief of Engineers desires the Board to take up the subject and report what additional work, if any, is required or necessary for the further improvement of the harbor.

* * * * * * *

By command of Brigadier-General Wright.

Very respectfully, your obedient servant,

JOHN G. PARKE,
Lieutenant-Colonel of Engineers,
Bvt. Maj. Gen., U. S. A.

Col. Z. B. TOWER,
Corps of Engineers.

have the honor to submit the following report:

Stonington Harbor opens into the east end of Fisher's Island Sound, opposite the passage way thence to the Atlantic. Though apparently covered from northeasterly and easterly storms the ground-swell of the ocean is felt in the harbor as far up as the inner wharves.

This harbor is more or less directly exposed to southeasterly and southerly storms, and prior to the construction of the westerly breakwater was entirely open to those from the southwest. Major Barlow, in his letter to the Chief of Engineers of June 16, 1875, advising the construction of the westerly breakwater, now essentially completed, says:

> All the testimony I have been able to gain upon the subject goes to show that the most annoying and dangerous seas are those occasioned by southwesterly winds following easterly gales. The most desirable immediate protection would therefore be obtained by the construction of a breakwater upon Wampasset Shoal.

The special Board of Engineers assembled June 30, 1875, in their discussion of various projects presented, confirmed the opinion of the local engineer, as follows:

> The first and largest harbor is to be constituted by extending a breakwater from the vicinity of Wampasset Point (the west point of the entrance from Fisher's Island Sound), in a general southeasterly direction, for a length of 2,000 feet, into about 18 feet of water at its outer end. The inner end of the breakwater is in 6 feet or less of water. Its trace is somewhat bent concave to the harbor. This structure will afford a very accessible harbor of refuge to vessels passing along the sound, and will thoroughly shelter them from southwest winds, which are represented as being the most violent and injurious of the locality, while it also provides protection in south and southeast winds, which are less severe but more common. This work also affords important protection to the more interior waters of the present harbor of Stonington.
>
> * * * * * * *
>
> The Board gives its preference to the first project as being the most satisfactory solution of the question before them.

The harbor of Stonington is very essentially benefited by the western breakwater, furnishing as it does a thorough protection against southwest gales, which, though short in duration, are sudden and severe. A reference to accompanying Coast Survey chart of Fisher's Island Sound shows, however, that the harbor is still quite open to south and southeast gales. During their prevalence they drive in between Montauk Point and the mainland a heavy ocean swell, which, though much broken by the rocks and shoals lying across the entrance to the sound, nevertheless extends northward between the courses *b a* and *d c*, and seriously disturbs the inner waters of the harbor.

The appropriation of $25,000 for improving Stonington Harbor was applied for and procured by prominent citizens of the locality, with a view to the construction of an eastern breakwater to be placed in advance of the western, in such a position as will effectually screen the harbor against the fore-mentioned storms from the southeast, and at the same time furnish a refuge for coastwise fleets, which, unable to face the gale, will seek cover behind it. Though there may be some difference of opinion as to the best position for this breakwater, the Board concurs essentially with Major Barlow in locating it between the Middle Ground and Bartlett's Reef, as shown by the lines A B, on accompanying sketch 2. A parallel position, about 1,000 feet distant, resting upon the inner or northern limit of Bartlett's Reef, is equally favorable, except that the greater depth of water on this site would involve a greater cost of construction.

In recommending the position indicated, the Board would remark that the length of the construction should be determined solely with a view to covering the waters north of it, and the inner harbor, from the waves and the ground-swell that in southeast gales, entering between Napatree and East Points, find their way up, as before stated, between the lines *b a* and *d c* into Stonington Harbor. It is thought that these waves are so much broken by the outer rocks and reefs, and by the shoal water in advance of Bartlett's Reef, as shown on the Coast Survey chart, that perhaps only the western portion of the breakwater, indicated in black, will be needed. We therefore think that the structure should be commenced at the fixed point O, sketch 2, and be built westward only so far as to effectually cover the entrance to the harbor in that direction. If any extension eastward from O be needed it can be made afterward, but only so far as to cut off the ground-swell in that direction. In other words, though the breakwater is indicated on accompanying sketch as reaching from Bartlett's Reef to the Middle Ground, there is no absolute reason for extending the structure to connect those two positions beyond that already given for covering the harbor entrance. The engineer in charge of this improvement will be able, in the process of its construction, to determine the length required for that purpose. All the waters to the north of this breakwater, to the limits of the inner harbor, will thus be made available as a harbor of refuge for the coast fleet in easterly storms.

With a maximum length of 2,000 feet the eastern breakwater, estimated at prices that ruled in the construction of the western, will cost:

2,000 feet, at $50	$100,000

There are forwarded to accompany this report: Coast Survey Chart of Fisher's Island Sound, and Sketch 2, showing position of proposed breakwater.

Respectfully submitted.

Z. B. TOWER,
Col. of Engineers and Bvt. Maj. Gen., U. S. A.
JOHN NEWTON,
Col. of Engineers and Bvt. Maj. Gen., U. S. A.

N. B.—General Abbot is absent on leave.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

C 2.

IMPROVEMENT OF NEW LONDON HARBOR. CONNECTICUT.

By the terms of an act of Congress, approved June 14, 1880, appropriating $25,000 for the improvement of Thames River, Connecticut, $2,500 of that sum was to be devoted to the removal of the shoal in New London Harbor. Proposals specifying separate prices for work in Thames River and in New London Harbor were invited by advertisement, and were opened August 5, 1880. The lowest bidder for the work in New London Harbor was not the lowest for the Thames River work, and he declined to execute a contract for the former alone; therefore all the bids for New London Harbor were rejected. Proposals were solicited anew by circular letters for this work alone, and were opened September 7, 1880. On this occasion the lowest bidder was William Flannery, of New York, with whom a contract was subsequently made.

Mr. Flannery began work October 6 and finished October 14, 1880, having removed 1,222 cubic yards of sand and gravel, making a depth of 16 feet at mean low-water over a part of the shoal, 180 feet long and from 25 to 50 feet wide, where the previous depth was from 12 to 16 feet.

During the whole course of this work the contractor met with none of the bowlders, uncertainty about which has been the cause of the high prices bid.

For this reason, when proposals were advertised for under the appropriation of $4,300 made by act of Congress approved March 3, 1881, separate prices were requested for bowlders of over a ton weight and for lighter material.

These proposals were received and opened June 15, 1881, and a contract for doing the work will be made with J. H. Fenner, of Jersey City, N. J.

In the annual report for 1878, I submitted an estimate of $6,800 as the amount necessary for the removal of this shoal to a depth of 16 feet below mean low-water. This was based on an estimate of 15 cents per cubic yard for the removal of sand and gravel, and $5 per cubic yard for bowlders.

The proposals received have been about three times as high as the estimates; the estimates were rather close at best, and prices for this class of work have risen somewhat since they were submitted, but there seems no sufficient reason why contractors should uniformly bid higher on this work than on the same kind of work elsewhere. At the rates offered at present the original estimates would have to be increased to about $24,000; this, less the amount already appropriated for this work, leaves $17,200 required for the completion of the project. The entire removal of this shoal could very well be accomplished in one year if the necessary funds were appropriated, and probably with greater economy than if it were divided up among two or three years.

New London Harbor is a harbor of such excellent natural advantages that, except the money expended upon this shoal, the government has never been asked to do anything for its improvement. The following sums have been appropriated by Congress for this work, viz:

June 14, 1880 (being part of Thames River appropriation)	$2,500
March 3, 1881	4,300

New London is the port of entry for the collection district of that name; the amount of revenue collected there during the fiscal year ending June 30, 1881, was $72,314.45.

Forts Trumbull and Griswold, near the mouth of Thames River, command the harbor. New London light-house is situated at the entrance to the harbor on the west shore.

Money statement.

July 1, 1880, amount available from appropriation of June 14, 1880, for improvement of Thames River, Connecticut	$2,500 00	
Amount appropriated by act approved March 3, 1881	4,300 00	
		$6,800 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,500 00
July 1, 1881, amount available		4,300 00
Amount (estimated) required for completion of existing project		17,200 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		17,200 00

Abstract of proposals opened August 5, 1880, *for the improvement of Thames River, Connecticut.*

Name and address of bidder.	Price per cubic yard.		To commence.	To complete.
	Shoal in New London Harbor.	River below Norwich.		
W. H. Beard, Brooklyn, N. Y	$3 50* 49	$0 24½	No date	June 30, 1881.
Henry E. Du Bois, New York, N. Y	No bid	50	.... do	June 30, 1881.
Joseph Cumings, New York, N. Y	1 60	27	.... do	June 30, 1881.
William Flannery, New York, N. Y.	0 47 3 47*	23	.... do	June 30, 1881.
Edgar M. Payn, Albany, N. Y	0 40	30	.... do	June 30, 1881.
H. N. & A. J. Beardsley, Bridgeport, Conn	8 00	26	... do	June 30, 1881.
McDermott & Daly, Cohoes, N. Y	0 60	30	.... do	June 30, 1881.

*Per ton for all stone over one ton.

All bids for shoal in New London Harbor rejected.

Abstract of proposals opened September 7, 1880, *for the improvement of Thames River, Connecticut. Shoal in New London Harbor*

Name and address of bidder.	Price per cubic yard.	To commence.	To complete.
John Van Patten, Philadelphia, Pa	$1 95	April 15, 1881	June 30, 1881
William Flannery, New York, N. Y	1 87	March 1, 1881	June 30, 1881
Morris & Cumings, Dredging Company, New York, N. Y	2 50	No date.	June 30, 1881

Abstract of proposals opened June 15, 1881, *for the improvement of New London Harbor, Connecticut.*

Name and address of bidder.	Price.		To commence.	To complete.
	Bowlders per ton.	Gravel per cubic yard.		
William Flannery, New York, N. Y	$4 64	$0 73	No date.....	Sept. 30, 1881
John McDermott. Cohoes, N. Y	4 50	0 60	... do	Sept. 30, 1881
John H. Fanner, Jersey City, N. J	4 40	0 49½	Nov. 1, 1881 .	July 1, 1882

Abstract of contract for the improvement of New London Harbor, Connecticut, in force during the fiscal year ending June 30, 1881.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Remarks.
William Flannery, New York, N. Y.	Oct. 5, 1880	Dredging	$1 87	Completed Oct. 14, 1880.

COMMERCIAL STATISTICS.

I am indebted to John A. Tibbits, collector of customs for the port of New London, for the following statement of revenue receipts and commercial statistics for that port for the year ending June 30, 1881:

REVENUE RECEIPTS.

Duties on imports	$60,010 62
Tonnage dues	760 50
Hospital tax	2,675 68
Miscellaneous receipts	8,867 65
Total collections	72,314 45
Number of foreign vessels arrived from foreign ports	14
Number of foreign vessels cleared for foreign ports	5
Number of American vessels arrived from foreign ports	16
Number of American vessels cleared for foreign ports	2
Number of vessels of all classes entered and cleared during the year	108
Total tonnage	19,972
Estimated value of cargoes received	$236,510 77
Estimated value of cargoes shipped	24,198 00

C 3.

IMPROVEMENT OF THAMES RIVER, CONNECTICUT.

The act of Congress approved June 14, 1880, which appropriated $25,000 to the improvement of the Thames River, specified that $2,500 of this amount should be expended in the removal of a shoal in New London Harbor. Proposals for the two works together, but at separate prices, were invited by advertisement, and were opened August 5, 1880. The bids for the New London work were all rejected, but a contract was entered into with William Flannery, of New York, N. Y., to do the Thames River work at 23 cents per cubic yard, he being the lowest bidder for that work.

Mr. Flannery promised to begin work early in the spring of 1881 and to provide ample appliances for pushing it vigorously, but being delayed by his machines freezing in during the winter and by other government contracts which he had been unable to complete as soon as expected, he did not appear on the ground until May 23, and then with but a single machine, with scows and tug-boat not at all adequate to finishing the work in the specified time. Mr. Flannery has removed up to the close of the fiscal year 9,387 cubic yards of sand from the bar below Mohegan Station, making a depth of 14 feet at mean low-water in a channel 1,450 feet long and 46 to 69 feet wide when the least previous depth was 10 feet. Work will be continued under an extension of the contract to September 30, 1881.

By act of Congress approved March 3, 1881, $30,000 was appropriated for the further improvement of this river, which, in accordance with a project submitted March 26, 1881, will be devoted to the construction of a dike 1,600 feet long on Trading Cove flats, and to continuing work on the 14-foot channel between Norwich and Indian Point. Proposals were advertised for in the usual way and opened June 15, 1881. William Flannery was the lowest bidder for dredging, but the contract has not yet been awarded. A contract for construction of a dike of piles with stone filling will be made with John C. Feltman, of Albany, N. Y.

Proposals for the dike were received both for a dike of piles filled with stone and for a dike of riprap granite, reserving the right to accept whichever was most economical; it was found that the least cost of the pile-dike would be $6,128, and of the riprap dike $6,550. The pile-dike has also this advantage over one of riprap stone, that it is not liable to settling, but preserves a permanent height.

According to estimates submitted in the annual report of 1880, excluding the estimate for New London Harbor, which was then presented with that for Thames River, the amount necessary for completing this work as projected is $96,700, less $22,500 and $30,000, since appropriated—$44,200. The amount required for repairing and building wing-dams is $20,000, making a total of $64,200. This could be advantageously expended in one year.

The importance of the commerce of the Thames River, and the necessity of keeping the channel open for navigation, have long been recognized by the government, and the following appropriations have been made by Congress for the improvement of the river:

Date.	Amount.	Remarks.
March 3, 1821	$150	Removing obstructions placed during war of 1812.
March 2, 1829	150	Survey.
July 4, 1836	10,000	Piers and dredging.
March 3, 1837	20,000	Do.
July 7, 1838	10,000	Do.
June 23, 1866	10,000	Dredging and survey.
March 3, 1867	72,000	Dredging.
March 3, 1871	15,000	Do.
June 10, 1872	10,000	Do.
June 18, 1878	10,000	Do.
March 3, 1879	12,000	Do.
June 14, 1880	22,500	Do.
March 3, 1881	30,000	Do.

New London, near the mouth of Thames River, is a port of entry. The amount of revenue collected during the fiscal year ending June 30, 1881, was $72,314.45. Forts Trumbull and Griswold near the mouth of the river command the harbor of New London; a light-house is situated on the west shore of the river at its mouth.

Money statement.

July 1, 1880, amount available	$25,404 13	
Amount appropriated by act approved March 3, 1881	30,000 00	
		$55,404 13
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	3,849 21	
July 1, 1881, outstanding liabilities	2,159 01	
		6,008 22
July 1, 1881, amount available		49,395 91
Amount (estimated) required for completion of existing project		64,200 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		64,200 00

Abstract of proposals opened August 5, 1880, *for the improvement of Thames River, Connecticut.*

Name and address of bidder.	Price per cubic yard.		To commence.	To complete.
	Shoal in New London Harbor.	River below Norwich.		
W. H. Beard, Brooklyn, N. Y	$3 50* 49	$0.24½	No date	June 30, 1881
Henry E. Du Bois, New York, N. Y	No bid	50	....do	June 30, 1881
Joseph Cumings, New York, N. Y	1 60	27	....do	June 30, 1881
William Flannery, New York, N. Y	47 3 47*	23	....do	June 30, 1881
Edgar M. Payn, Albany, N. Y	40	30	....do	June 30, 1881
H. N. & A. J. Beardsley, Bridgeport, Conn	8 00	26	....do	June 30, 1881
McDermott & Daly, Cohoes, N. Y	60	30	....do	June 30, 1881

* Per ton for all stone over one ton.
All bids for shoal in New London Harbor rejected.

Abstract of proposals opened June 15, 1881, *for improvement of Thames River, Connecticut, Dredging.*

Name and address of bidder.	Price per cubic yard.	To commence.	To complete.
Wm. Flannery, New York, N. Y	$0 27	No date	June 30, 1882
J. H. Fenner, Jersey City, N. J	28	....do	June 30, 1882
H. N. & A. J. Beardsley, Bridgeport, Conn	35	....do	June 30, 1882
Frank Pidgeon, jr., Philadelphia, Pa	29	Dec. 1, 1881	June 30, 1882

Abstract of proposals opened June 15, 1881, *for construction of dike in Thames River, Connecticut.*

Name and address of bidder.	Stone.	Piles.	To commence.	To complete.
	Price per ton.	Price per linear foot.		
Henry Du Bois & Sons, New York, N. Y	$2 00	$6 50	No date	June 30, 1882
Simeon C. Fraser, New London, Conn	....	*5 15 †4 00	....do	June 30, 1882
Thomas T. Wetmore, New London, Conn	....	7 73	....do	June 30, 1882
Fred'k K. Ballou, Boston, Mass	1 39	....	....do	June 30, 1882
Stephen A. Kelly, Brooklyn, N. Y	....	6 75	....do	June 30, 1882
John C. Feltman, Albany, N. Y	....	‡3 83	....do	June 30, 1882
James Scully, Groton, Conn	1 31	.....	....do	June 30, 1882

*Complete. †Without stone. ‡No signature of certifying official.

Abstract of contract for the improvement of Thames River, Connecticut, in force during the fiscal year ending June 30, 1881.

Name and address of contractor.	Subject of contract.	Date of contract	Price per cubic yard.	Remarks.
William Flannery, New York, N. Y	Dredging	Oct. 5, 1880	$0 23	Extended to Sept. 30, 1881.

COMMERCIAL STATISTICS.

Through the courtesy of the New London Tow Boat Company the following record of tonnage on Thames River for the two years ending June 30, 1881, has been obtained. This includes probably nine-tenths of the commerce of the river to Norwich, exclusive of the business done by steamers:

	1879–'80.	1880–'81.
July	14, 135	15, 326
August	8, 402	12, 718
September	11, 917	12, 413
October	9, 047	16, 206
November	15, 477	16, 084
December	15, 847	14, 643
January	8, 291	5, 994
February	3, 604	4, 689
March	13, 642	17, 4[illegible]6
April	17, 817	20, [illegible]8
May	17, 849	16, 499
June	13, 074	26, 012
	149, 102	178, 108

Total for two years, 327,210 tons.

The following estimate of the amount of business of the Norwich line of steamers for the past ten years has been presented by Capt. S. A. Gardner, superintendent:

Number of tons received	287, 450
Number of tons forwarded	320, 000

C 4.

IMPROVEMENT OF NEW HAVEN HARBOR, CONNECTICUT.

At the time of writing the last annual report, the work of widening the 16-foot channel was in progress under an extension of contract with Messrs. H. N. & A. J. Beardsley, of Bridgeport, Conn. This contract was completed July 16, 1880, by the removal of 145,000 cubic yards of material, making 16 feet depth at mean low-water, where was previously from 10 to 13 feet, in a channel 280 feet wide from Belle Dock to Long Wharf, and 540 feet wide at the bend at Long Wharf.

By act of Congress approved June 14, 1880, $15,000 was appropriated for the further improvement of the harbor, which it was proposed to expend in widening the 16-foot channel. Proposals were invited by advertisement and were opened August 5, 1880. The lowest bidder was the Morris and Cumings Dredging Company, of New York, with whom a contract was made at the rate of 12¼ cents per cubic yard of material removed and deposited in Long Island Sound, at a point 2 miles beyond Southwest Ledge. Work was begun under this contract August 23, 1880, and completed October 25, 1880, 110,000 cubic yards of material having been removed. The result has been to widen the 16-foot channel to 400 feet from Belle Dock to Long Wharf, to 300 feet from Long Wharf to Black Buoy No. 5, opposite Crane's Bar, and to make the bend at Long Wharf 580 feet wide. The material taken out has been mud, except a small amount of sand and gravel at the upper end of the work, near Tomlinson's Bridge, and a thin layer of sand opposite the new sewer.

The appropriation of $15,000 made by act of Congress approved March 3, 1881, will be applied to increasing the width of the channel above Fort Hale. It is believed that this will be sufficient to make the 16-foot channel at least 400 feet wide from that point to the upper end of the harbor. After the usual advertisement proposals for doing this work were opened June 15, 1881, and a contract will be entered into with H. N. & A. J. Beardsley, of Bridgeport, Conn., they being the lowest bidders.

The most serious obstacle in the way of a 16-foot channel from Long Island Sound to Tomlinson's Bridge, is at present the bar below Fort Hale. In 1872 and 1873, a channel 200 feet wide and 16 feet deep was dredged through this bar; recent examinations show that the available depth across this bar is 13½ feet, being about 2 feet greater than before the work, but the channel as dredged is scarcely distinguishable from the adjoining bottom.

In October, 1880, borings were made in this bar west of the old channel. At two points, about 600 feet west of that channel and in 14 and 15 feet of water, were found, respectivly, 29 and 30 feet of very soft mud; below this 1.5 and 2.7 feet of stiff mud and then sand; at points 1,200 to 1,500 feet farther west, in water from 1 to 6 feet deep, was found 30 to 35 feet of mud with occasional thin layers of sand near the top. Out of fourteen borings only two failed to show great depths of soft mud; these two were near the west shore and at a depth of 9 feet; the sand was too compact to bore. At all points where vessels can cross the bar, the depth of soft mud is very great, and it is probable that a channel once cut through there could not be preserved. The bar is formed, as the map shows, at a point where the harbor rapidly widens, particularly on the west side, which widening must materially diminish the erosive effects of the tidal currents. There seems no doubt that, could the width here be diminished, the currents would cut out this mud very rapidly and keep open a channel of greater depth than now. This would be best accomplished by a dike running out from Sandy Point, with an ell running toward the sound; the proper length of this dike would be more or less a matter of experiment, but it should be at least 4,400 feet long, further addition being governed by the effect of that amount of work. I mentioned this plan in my last annual report, and I now recommend that an appropriation be asked for for the construction of this dike during the fiscal year ending June 30, 1883. The 4,400 feet length, mentioned above, would cost about $60,000; it would be better as well as cheaper that this should all be constructed at once. It could readily be done within one year.

The following amounts have been appropriated for the improvement of New Haven Harbor since 1870:

July 11, 1870	$15,000
March 3, 1871	40,000
June 10, 1872	20,000
March 3, 1873	25,000
March 3, 1875	10,000
June 18, 1878	25,000
March 3, 1879	15,000
March 3, 1879, breakwater	30,000
June 14, 1880	15,000
June 14, 1880, breakwater	30,000
March 3, 1881	15,000
March 3, 1881, breakwater	60,000

New Haven is the port of entry for the collection district of New Haven. The amount of revenue collected there for the fiscal year ending June 30, 1881, was $261,056.52.

There is a light-house on Southwest Ledge at the mouth of the harbor. Fort Hale, 2 miles below the city, on the east shore, commands the channel.

Money statement.

July 1, 1880, amount available	$19,790 55	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$34,790 55
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		16,665 82
July 1, 1881, amount available		18,124 73
Amount (estimated) required for completion of existing project		60,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		60,000 00

Abstract of proposals opened August 5, 1880, for the improvement of New Haven Harbor, Connecticut.

Name.	Address.	Price per cubic yard.	To commence.	To complete.
Morris and Cumings Dredging Company	New York	$0 12½	No date	June 30, 1881
William Flannery	do	14½	do	June 30, 1881
H. N. & A. J. Beardsley	Bridgeport, Conn	15	do	June 30, 1881
Henry E. Du Bois	New York	16	do	June 30, 1881

Abstract of contract for the improvement of New Haven Harbor, Connecticut, in force during the fiscal year ending June 30, 1881.

Name.	Address	Date of contract.	Subject of contract.	Price per cubic yard.	Remarks.
Morris and Cumings Dredging Company	New York	Aug. 27, 1880.	Dredging	$0 12½	Completed October 25, 1880.

Abstract of proposals opened June 15, 1881, for the improvement of New Haven Harbor, Connecticut.

Name.	Address.	Price per cubic yard.	To commence.	To complete.
Frank Pidgeon, jr	Philadelphia, Pa	$0 17	Mar. 1, 1882.	Aug. 1, 1882
H. N. & A. J. Beardsley	Bridgeport, Conn	11½	July 10, 1881.	Jan'y 10, 1882
C. M. Pratt	New York, N. Y	14	No date.	June 30, 1882

COMMERCIAL STATISTICS.

Approximate amount of materials received and shipped in New Haven Harbor, Connecticut, during the ten years ending June 30, 1880.

	For the year ending June 30—									
	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.
Domestic receipts:										
Coal .... tons.	420,700	450,000	542,400	500,000	460,300	450,000	462,700	458,800	650,200	675,000
Iron .... tons.	25,000	26,500	27,500	26,500	26,000	25,500	27,000	29,000	31,000	32,500
Lumber .... 1,000 feet.	50,000	51,000	51,000	49,000	48,000	47,500	48,300	49,700	51,000	52,500
General mdse .... tons.	640,000	780,000	790,000	740,000	695,000	650,000	710,000	735,000	760,000	800,000
Foreign receipts:										
Rags .... tons.	......	1,402	1,040	1,751	2,426	1,479	2,908	2,245	2,108	1,535
Sugar & molasses . hhds.	15,464	12,016	11,798	17,617	17,511	15,503	14,726	16,277	16,013	14,278
Domestic shipments:										
General mdse .... tons	470,000	530,000	520,000	480,000	462,000	490,000	528,000	530,000	564,000	615,000
Foreign shipments:										
Meat .... tons.	......	......	......	......	......	8,500	11,000	14,000	14,500	15,000
Number of vessels arriving and departing:										
Steamers	......	......	......	......	......	3,500	3,560	4,206	4,310	4,750
Sailing vessels	......	......	......	......	......	6,950	8,368	6,972	6,980	9,420
Barges	......	......	......	......	......	2,600	3,040	2,520	4,080	4,675

Through the courtesy of the collector of New Haven, I am enabled to present the following commercial statistics for the last fiscal year:

CUSTOM HOUSE, NEW HAVEN, CONN.,
Collector's Office, July 26, 1881.

Statement showing the receipts of revenue collections and commercial statistics at the port of New Haven for the fiscal year ending June 30, 1881.

Number of vessels entered from foreign ports	100
Number of vessels cleared for foreign ports	44
Value of merchandise imported	$825,521 00
Value of merchandise exported	96,431 00
Amount of duties collected	$253,117 92
Tonnage dues collected	2,053 50
Hospital dues collected	2,727 75
Miscellaneous items	3,157 35
Total collections	261,056 52
Entries and clearances coastwise, steamers	1,043
Entries and clearances coastwise, sail-vessels	740

Estimated value of cargoes of vessels entered and cleared coastwise as follows:

Received.

	Value.
Coal, 650,000 tons	$3,250,000
Lumber of all descriptions	2,500,000
Iron, 41,758 tons	1,443,950
Miscellaneous items, 351,184 tons	65,596,250
	72,790,200

Shipped.

Miscellaneous items, 300,400 tons	$66,150,000

C 5.

CONSTRUCTION OF BREAKWATER AT NEW HAVEN, CONNECTICUT.

Under contract with Francis H. Smith, of New York, 5,976 tons of stone had been deposited in the breakwater, July 1, 1880. The time of this contract extended to September 30, 1880. Up to October 30, Mr. Smith placed 14,192 tons of stone in the work, and to November 10, one of his bondsmen placed 200 tons which were authorized to be received. Then, after advertisement, a new contract was made, dated November 15, 1880, with Arnold & Stephens, of Oneida, N. Y., to deliver about 16,000 tons, being the remainder of the contract which Mr. Smith failed to complete. This contract was completed May 20, 1881, by the delivery of 17,000 tons, the total length of breakwater built and finished by this and Mr. Smith's contract being 348 feet.

Under an appropriation of $30,000 made by act of Congress approved June 14, 1880, proposals were advertised for and opened August 5, 1880, after which a contract was entered into with John Beattie, of Leete's Island, Connecticut, the lowest bidder, for the delivery of about 33,000 tons of granite in the breakwater at the rate of 81 cents per ton. Mr. Beattie completed this contract May 4, 1881, by the delivery of the required amount of stone, increasing the length of the finished work by 342 feet. The total length of breakwater at the end of the fiscal year is 690 feet.

Sixty thousand dollars was appropriated by act of Congress approved March 3, 1881. After the usual advertisement, proposals were opened June 15, 1881; all bids received being considered too high were rejected, and advertisements dated July 1, 1881, are now issued inviting new proposals to be opened July 19. The new proposals are to admit of offers of 10,000 or more tons of granite, hoping in this way to receive proposals from contractors whose facilities may not be great enough for undertaking the whole work.

This breakwater is a work of the greatest importance, not to the commerce of New Haven in particular, but to all vessels passing back and forth through Long Island Sound, and it is highly desirable that it be completed as soon as possible. To finish the eastern breakwater in three years' time would require, according to estimates previously submitted, about $200,000 each year, and it is recommended that an appropriation to that amount be asked for.

The following amounts have been appropriated for this work, viz:

March 3, 1879	$30,000
June 14, 1880	30,000
March 3, 1881	60,000

Money statement.

July 1, 1880, amount available	$52,877 22	
Amount appropriated by act approved March 3, 1881	60,000 00	
		$112,877 22
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		52,583 37
July 1, 1881, amount available		60,293 85
Amount (estimated) required for completion of existing project		1,191,134 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		200,000 00

Abstract of proposals opened August 5, 1880, *for construction of breakwater in New Haven Harbor, Connecticut.*

Name and address of bidder.	Price per gross ton.	To commence.	To complete.
John Beattie, Leete's Island, Connecticut	$0 81	No date	June 30, 1881
Justin Arnold, Clinton Stephens, Brooklyn, N. Y	0 97½	do	June 30 1881
James Scully, Groton, Conn	1 00	do	June 30, 1881
F. K. Ballou, Boston, Mass	1 19	do	June 30, 1881
F. H. Smith, New York, N. Y	1 55	do	June 30, 1881

Abstract of proposals opened November 10, 1880, *for improvement of New Haven Harbor, Connecticut; delivering stone.*

Name and address of bidder.	Price per gross ton.	To commence.	To complete.
John Beattie, Leete's Island, Connecticut	$1 00	No date	June 30, 1881
Arnold & Stephens, Oneida, N. Y	0 88½	do	June 30, 1881
Frederick K. Ballou, Boston, Mass	0 99½	do	June 30, 1881
James D. Leary, New York, N. Y	0 89	do	June 30, 1881

Abstract of proposals opened June 15, 1881, for construction of breakwater at New Haven, Conn.

Name and address of bidder.	Price per gross ton.	To commence.	To complete.	Remarks.
John Beattie, Leete's Island, Connecticut.	$1 31½	No date.....	June 30, 1882	
Frederick K. Ballou, Boston, Mass.	1 33	....do	June 30, 1882	No affidavit of sureties.
Chauncey D. Allen, Westfield, Mass.	1 32	....do	June 30, 1882	
D. V. Howell, Monroe, N. Y	1 21	....do	June 30, 1882	Informal.

All of these proposals rejected as being too high.

Abstract of contracts for riprap granite in New Haven Breakwater, Connecticut, in force during the fiscal year ending June 30, 1881.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per gross ton.	Remarks.
Francis H. Smith, New York.......	Mar. 12, 1880	Riprap granite....	$0 89	Failed to complete.
John Beattie, Leete's Island, Connecticut.	Aug. 16, 1880	....do	81	Completed May 4, 1881.
Arnold & Stephens, Oneida, N. Y..	Nov. 15, 1880	....do	88½	Completed May 20, 1881.

REPORT OF MR. H. B. GORHAM, INSPECTOR.

NEW HAVEN, CONN., *June* 3, 1881.

SIR: I have the honor to submit the following report on the construction of the breakwater at the entrance to New Haven Harbor, Connecticut, during the fiscal year ending June 30, 1881.

The first appropriation by Congress for this breakwater, $30,000, was made by act approved March 3, 1879, but the location not having been decided upon, operations were not begun until April 22, 1880. At the beginning of this fiscal year, work was going on under a contract with Francis H. Smith, of New York, who, up to that time, had delivered 5,976 tons of granite, being a daily average of about 100 tons, and had built 70 feet of breakwater. Operations were carried on at about the same rate during the summer, and it became evident that, unless this rate was largely increased, the contract would not be finished in the specified time. About August, Mr. Smith opened a quarry at Town Neck Point, about a half mile west from his other quarry at Double Beach, but the stone was of inferior quality and partly disintegrated, and was therefore refused. He then opened another quarry on the Branford River, which supplied 1,300 tons of stone during the continuance of his contract.

By act of Congress approved June 14, 1880, $30,000 was appropriated for continuing the construction of this breakwater, and on August 16, 1880, a contract was entered into with John Beattie, of Leete's Island, Connecticut, for the delivery of 33,000 tons of riprap granite at 81 cents per ton. Mr. Beattie at once began sending stone from his quarry at Leete's Island, about 13 miles east of Southwest Ledge, using three sailing vessels of 375 tons combined capacity. He began work on the line of the breakwater about 400 feet east from the beginning, and continued easterly. Mr. Smith's work at that time being about 135 feet from the beginning, this enabled both contracts to be carried on simultaneously, without interfering with each other. About October 1, Mr. Beattie substituted for his sailing vessels two larger vessels, together 400 tons capacity, towed by a tug-boat to and from the work; this was found advantageous, less time being lost by reason of adverse winds and tides.

On account of the slowness of his work Mr. Smith's contract was abrogated after he had delivered 14,192 tons of stone (less than half the stipulated amount, the full time having already expired), finishing 188 feet of the breakwater. The average depth of water over this distance was about 20 feet, and the bottom hard, it being part of the ledge. Mr. Smith's bondsman, James D. Leary, of New York, requested and was permitted to continue delivery of stone until a new contract should be made; there was some delay in obtaining vessels and he sent only 200 tons.

November 10, the new contract was awarded to Messrs. Arnold & Stephens, of Oneida, N. Y., for delivery of about 16,000 tons of granite at 88½ cents per ton, to finish on or before June 30, 1881. They used the same vessels and quarries that Mr. Smith had used, and began delivering stone November 15, but suspended on the 18th, their tug-boat being disabled. Work was resumed December 22.

In the mean time Mr. Beattie's work had been carried on without interruption. In

December, he increased his freighting capacity to 661 tons and again in February to 893 tons, employing six vessels.

During the winter, work on both contracts was continued, though necessarily more slowly, as the vessels were sometimes frozen in at the quarries.

In March, Mr. Beattie worked at the west end of his section, so that when the contracts were completed the gap between the two parts was closed; his contract was completed May 4, 1881, he having built 342 feet length of breakwater, where the average depth of water was 23 feet and the bottom soft.

Messrs. Arnold & Stephens finished their contract May 20, 1881, having delivered 17,000 tons of granite and built 160 feet of breakwater besides finishing off about 80 feet left uncompleted by Mr. Smith; the average depth of water was 22 feet, the bottom being hard for the first 60 feet and soft the remaining 100 feet of the length.

The total number of tons of stone delivered in the breakwater is 64,392, completing a total length of 690 feet. Vessels already take advantage of the shelter afforded, and frequently anchor behind the breakwater in rough weather.

Appended is a summary, showing the work done by the different contractors.

Respectfully submitted.

HENRY B. GORHAM.

J. W. BARLOW,
Major of Engineers, Bvt. Lieut. Col., U. S. A.

Summary of work on the New Haven Breakwater.

Date.	By Francis H. Smith.		By James D. Leary.		By Arnold & Stephens.		By John Beattie.		Total.	
	Length in feet.	Tons delivered.	Length in feet.	Tons delivered.	Length in feet.	Tons delivered.	Length in feet.	Tons delivered.	Length in feet.	Tons delivered.
1880.										
April	10	934							10	934
May	25	2,241							25	2,241
June	35	2,801							35	2,801
July	34	2,503							34	2,503
August	46	2,800					15	1,535	61	4,335
September	12	795					25	2,445	37	3,240
October	26	2,118					35	2,960	61	5,078
November				200	9	500	27	2,555	36	3,255
December					13	1,006	42	3,129	55	4,135
1881.										
January					20	1,818	40	3,565	60	5,383
February					15	1,616	31	4,380	46	5,996
March					25	3,601	59	5,254	84	8,855
April					62	5,208	68	6,853	130	12,061
May					16	3,251		324	16	3,575
Total	188	14,192		200	160	17,000	342	33,000	690	64,392

COMMERCIAL STATISTICS.

Return of vessels which have passed by or in the vicinity of the light-house at Southwest Ledge, during the year ending 30th day of June, 1881.

Quarter ending—	Ships.	Barks.	Brigs.	Schooners.	Sloops.	Steamers.	Total for quarter.
September 30	4	15	35	1,817	384	1,343	3,598
December 31	3	21	40	2,255	328	1,208	3,855
March 31	7	12	30	1,160	241	1,092	2,542
June 30	2	16	42	1,695	555	1,816	4,126
Totals	16	64	147	6,927	1,508	5,459	14,121

THE COMMERCE OF THE SOUND.

During the year ending June 30, 1881, the record kept on board the Bartlett's Reef light-ship shows that the total number of vessels passing that point was 41,969. The classification of them is as follows: Ships, 46; barks, 346; brigs, 313; schooners, 23,629; sloops, 5,101; steamers, 10,327; barges, 2,200. This record, of course, is not accurate, as many vessels have passed in the night-time and during thick weather, of which no account has been taken. Captain Tinker, keeper of the light-ship, estimates that the grand total would reach at least 56,000.

Bartlett's Reef is about 44 miles east of Southwest Ledge, and about 4 miles from the entrance to New London Harbor.

LETTER FROM THE COLLECTOR OF CUSTOMS.

CUSTOM-HOUSE, NEW HAVEN, CONN.,
Collector's Office, June 27, 1881.

SIR: New Haven being the seventh seaport for customs duties paid into the Treasury of the United States, and on the road of vessels bound to New York, by its eastern entrance through Long Island Sound, commerce demands that a liberal appropriation for the breakwater off the entrance to this harbor should be made. In my opinion, the importance of the work now in process of construction is such that an appropriation should be made of not less than $300,000.

Respectfully,

AMOS J. BEERS, *Collector*.

Maj. J. W. BARLOW.

LETTER FROM THE MAYOR OF NEW HAVEN, CONN.

MAYOR'S OFFICE, NO. 7, CITY HALL,
New Haven, Conn., June 28, 1881.

DEAR SIR: I understand you are about to make your report to the department as to the condition and progress of the breakwater in our harbor. I therefore take this opportunity to request you to urge upon the department the importance and necessity of completing this work and making an appropriation sufficient for that purpose.

Thanking you for the interest you have heretofore exerted in behalf of the project, I remain, dear sir, yours, very truly,

JNO. B. ROBERTSON, *Mayor*.

Col. J. W. BARLOW,
Major of Engineers, U. S. A.

C 6.

IMPROVEMENT OF MILFORD HARBOR, CONNECTICUT.

The sum of $5,000 was appropriated for the further improvement of this harbor by act of Congress approved June 14, 1880. Advertisement was made, and August 5, 1880, proposals were opened for dredging between the Town Wharf and the Straw Works, and between Merwin's Wharf and Long Island Sound. A contract was entered into with John M. Seward, of Albany, N. Y., the lowest bidder, and work was begun September 16, 1880. It was soon discontinued, and resumed again in March, 1881. The contract was completed June 15, 1881, by the removal of 15,068 cubic yards of mud above Town Wharf, and 12,000 cubic yards of sand below Merwin's Wharf.

The plan for the expenditure of the last appropriation contemplated completing the channel 60 feet wide and 4 feet deep to the Straw Works, with a turning-basin at the end, and repairingt he channel at the entrance of the harbor where it had partially filled. After finishing the upper channel it was found that the filling of the entrance channel was not nearly so great as had been represented, and also that part of this had been removed through the enterprise of citizens of Milford, the whole contemplated work being thus completed before the available funds were exhausted. At the earnest solicitation of those most interested in the works of improvement there, an experimental channel, 25 feet wide and 8 feet deep, was cut through the bar at the entrance, lying within and on the west side of the 4-foot channel already made. This is now of great use to steam-vessels employed in the fish-oil works at that place, and it is claimed that the increase of shipping in the harbor, particularly in the oyster business, for which those waters seem very well adapted, will soon require an 8-foot channel of fully 100 feet width. Such a channel would involve the removal of about 45,000 cubic yards more of material, principally sand and gravel, which, at ruling prices, would cost, including superintendence and incidental expenses, about $11,000.

The condition of the channel above Merwin's Wharf appears to give satisfaction, and no further work is required there at present.

The total amount dredged in this harbor since the first appropriation for its improvement in 1874, is 113,123 cubic yards. The effect of improvements since that time has been the protecting of the east shore from erosion, the construction of jetties at the mouth of Indian River and at Burns's Point to direct the action of the tidal currents, and the making of a 4-foot channel, 60 feet wide, from the village wharves to Town Wharf, 75 feet wide to Merwin's Wharf, and 100 feet wide from the last to deep water in Long Island Sound, of which last length 25 feet in width has been made 8 feet deep at mean low-water.

By act of Congress approved March 3, 1881, a survey for breakwater and harbor of refuge at Milford, Conn., was directed. This will be made during the coming summer, and maps and estimates of cost prepared.

The following sums have been appropriated by Congress for the improvement of Milford Harbor, viz:

June 23, 1874	$5,000 00
March 3, 1875	13,000 00
June 18, 1878	10,000 00
June 14, 1880	5,000 00

Milford is in the New Haven collection district, of which New Haven is the port of entry. The amount of revenue collected there for the year ending June 30, 1881, was $261,056.52.

The nearest light-house is on Stratford Point, 4 miles distant. Fort Hale, New Haven Harbor, the nearest work of defense, is 9 miles distant.

Money statement.

July 1, 1880, amount available	$5,177 33
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	5,101 14
July 1, 1881, amount available	76 19
Amount that can be profitably expended in fiscal year ending June 30, 1883	11,000 00

Abstract of proposals opened August 5, 1880, *for the improvement of Milford Harbor, Connecticut.*

Name and address of bidder.	Price per cubic yard.		No. of yards that can be removed.		To commence.	To complete.
	Between Town Wharf and Straw Works.	Below Merwin's Wharf.	Between Town Wharf and Straw Works.	Below Merwin's Wharf.		
William Flannery, New York, N. Y.	$0 18	$0 22	15,000	8,181	No date	June 30, 1881.
McDermott & Daly, Cohoes, N. Y.	16	22	15,000	9,544	do	June 30, 1881.
John M. Seward, Albany, N. Y.	16½	17	15,000	11,911	do	June 30, 1881.

Abstract of contract for improvement of Milford Harbor, Connecticut, in force during the fiscal year ending June 30, 1881.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.		Remarks.
			Between Town Wharf and Straw Works.	Below Merwin's Wharf.	
John M. Seward, Albany, N. Y.	Sept. 13, 1880	Dredging...	$0 16½	$0 17	Completed June 15, 1881.

EXTRACT FROM REPORT OF MR. W. A. PECK, JR., INSPECTOR.

In pursuance of your instructions, dated March 21, 1881, I went to Milford to assume charge of the work there. The dredge did not arrive until the 30th of the month, having been delayed by inclement weather, and work was commenced on the 31st at the mouth of Indian River. After removing 900 yards from that locality and making a channel 150 feet long, 40 feet wide, and 8 to 9 feet deep at mean low-water, this work was interrupted and dredging begun on the 4-foot channel above Town Wharf, April 6. This latter channel was completed May 19, 1881, by the removal of 15,068 cubic yards of mud, when work was resumed below the mouth of Indian River and completed June 15, after the further removal of 8,589 cubic yards of sand; so that there has been made one cut from Merwin's Wharf to the 8-foot curve, 25 feet wide, except that for about 300 feet in the vicinity of the mouth of Indian River, the width is 40 to 45 feet.

The condition of the channel now is this: From deep water to the long jetty, 4 feet deep for a width of 100 feet; from the long jetty to Merwin's Wharf, 4 feet deep and 75 feet wide, the turn being made 150 feet wide from Merwin's Wharf to Town Wharf, 4 feet deep and 60 feet wide, and from Town Wharf to the village wharves, 4 feet deep and 40 feet wide, with a turning-basin at the end; also on the west side of, but within, the channel below Merwin's Wharf, a cut 25 feet wide has been made 8 feet deep at mean low-water.

The commerce of Milford is limited to the coal supply, which amounts to 7,000 or 8,000 tons annually, the oyster trade, and the fish-oil trade. The saving on the item of coal alone, caused by the improvements, principally by reason of reduction of freights and by obviating the expense of lighterage, is 50 cents per ton (*i. e.*, from $3,500 to $4,000 per year). The 8-foot channel is of great use to those engaged in the fish-oil business, for their steamers find it necessary to go up the harbor for fresh water, often when a delay on account of tides would be a serious drawback; it is also of use to the oyster interest for steam-dredges. This last business is of growing importance, two new companies having, as I am told, decided to locate here since the improvements have been under way. It will, of course, make the needs of good water in the channel greater from year to year. I would suggest the necessity of a greater width to the 8-foot channel.

The filling in of the channel at the mouth of Indian River is a serious obstruction at times, and measures to prevent it, if effectual, would be of great benefit to those who use the channel.

Above Town Wharf the ice gorge of last winter so changed the course of the water as to wash the mud from the banks and deposit it in the channel. The amount of material that had to be removed was considerably increased, the part of the channel above the wharf being filled, in places, as much as 1½ feet. In consequence of this, two cuts, 25 feet wide, were made up the channel from the wharf, to repair the previous work.

Respectfully submitted.

W. A. PECK, JR.,
Inspector.

Col. J. W. BARLOW.

COMMERCIAL STATISTICS.

Approximate amount of materials received in and shipped from Milford Harbor, Connecticut, for the ten years ending June 30, 1881.

	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.
Received, year ending June 30:										
Coal, tons	6, 000	6, 000	6, 000	6, 000	6, 000	7, 000	8, 000	8, 000	8, 000	10, 000
Lumber, 1000 feet	1, 000	1, 000	1, 000	1, 000	1, 000	1, 000	1, 000	1, 000	1, 250	1, 500
General merchandise, tons	930	930	930	930	1, 070	1, 075	1, 165	1, 220	1, 525	1, 525
Shipped—year ending June 30:										
Oysters, barrels	......	......	......	......	......	......	......	......	......	3, 000
Number of vessels arriving and departing:										
Steamers	......	......	......	......	......	......	......	......	28	40
Sailing-vessels	......	......	......	......	......	......	......	......	120	160
Barges	......	......	......	15	15	18	20	20	30	30
Number of vessels harboring in river:										
Steamers	......	......	......	......	......	......	......	......	......	27
Sailing-vessels	......	......	......	......	......	......	......	......	......	229

C 7.

IMPROVEMENT OF HOUSATONIC RIVER, CONNECTICUT.

By act of Congress approved June 14, 1880, $2,000 was appropriated for the improvement of the Housatonic River. Proposals were opened August 5, 1880, after the customary advertisement, and a contract was subsequently entered into with John M. Seward, of Albany, N. Y., for dredging channels, 60 feet wide and 7 feet deep at mean low-water, at Mill Bar, at the rate of 16 cents, and at the "Bend" below Stratford at the rate of 20 cents per cubic yard. Before work was begun, which was not until May 13, 1881, the winter and spring freshets had modified the condition of the channel so that, while little trouble was experienced at Mill Bar the condition of the "Bend" had become much worse, and it was found the whole appropriation could be most advantageously expended at the latter place. This was done, resulting in making the 7-foot channel 75 feet wide for a length of 900 feet, straightening what had been a very crooked and narrow channel, and making it lie in the course of, instead of across, the tidal currents; on account of this last fact it is hoped the channel will be tolerably permanent. Nine thousand two hundred and ninety cubic yards of sand were removed from this place and deposited in deep water in Long Island Sound, completing the contract June 16, 1881.

The further sum of $2,000 was appropriated for this improvement by act of Congress approved March 3, 1881. It is contemplated expending this upon shoals formed during the past year, principally a mile below and a short distance above Drew's Rock. Advertisement was made, and proposals for doing this work were opened June 15, 1881.

Any improvement made on this river, short of the complete diking of the channel, would require frequent additional work to remove the shoals which every freshet is liable to form. For the removal of such, and for the general preservation of the channel, it is estimated that $5,000 could be advantageously expended for the fiscal year ending June 30, 1883.

The following sums have been appropriated by Congress for the improvement of the Housatonic River, viz:

March 3, 1871	$15, 000
June 10, 1872	15, 000
March 3, 1873	10, 000
June 23, 1874	10, 000

March 3, 1875	$5,000
June 18, 1878	5,000
June 14, 1880	2,000
March 3, 1881	2,000

The Housatonic River is the boundary between New Haven and Fairfield collection districts.

There is a light-house on Stratford Point at the mouth of the river, and one on Stratford Shoal, Long Island Sound.

The nearest work of defense is Fort Hale, New Haven Harbor, 13 miles distant.

Money statement.

July 1, 1880, amount available	$2,122 68	
Amount appropriated by act approved March 3, 1881	2,000 00	
		$4,122 68
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,070 08
July 1, 1881, amount available		2,052 60
Amount that can be profitably expended in fiscal year ending June 30, 1883.		5,000 00

Abstract of proposals opened August 5, 1880, *for the improvement of Housatonic River, Connecticut.*

Name and address of bidder.	Price per cubic yard.		To commence.	To complete.
	Mill Bar.	Bend below Stratford.		
William Flannery, New York, N. Y	$0 19	$0 26	No date	June 30, 1881
McDermott & Daly, Cohoes, N. Y	20	25	... do	June 30, 1881
John M. Seward, Albany, N. Y	16	20	... do	June 30, 1881

Abstract of proposals opened June 15, 1881, *for the improvement of Housatonic River, Connecticut.*

Name and address of bidder.	Price per cubic yard.	To commence.	To complete.
John McDermott, Cohoes, N. Y	$0 23	No date	June 30, 1882

Abstract of contract for the improvement of Housatonic River, Connecticut, in force during the fiscal year ending June 30, 1881.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.		Remarks.
			Mill Bar.	Bend below Stratford.	
John M. Seward, Albany, N. Y	Sept. 13, 1880	Dredging	$0 16	$0 20	Completed June 16, 1881

COMMERCIAL STATISTICS.

OUSATONIC WATER COMPANY,
Birmingham, Conn., July 25, 1881.

DEAR SIR: I inclose you herewith returns of the business on the Housatonic River for the ten years, and also for the current year. They are not as full as I hoped to have made them, as I find it almost impossible to get returns from the different wharves.

Very respectfully, yours,

E. N. SHELTON,
President.

Maj. J. W. BARLOW.

Approximate amount of materials received by water at Birmingham, Conn., and other points on the Housatonic River, for the ten years ending June 30, 1880.

Year ending June 30—	Coal.	Iron.	Brick.	Lumber.	General merchandise.
	Tons.	*Tons.*	*Number.*	*Feet.*	*Tons.*
1871	13,000	1,500	....	2,000,000	2,500
1872	14,000	1,800	....	1,600,000	2,200
1873	16,000	1,900	....	1,700,000	2,800
1874	14,000	1,200	....	1,600,000	2,200
1875	16,000	2,000	....	1,650,000	2,500
1876	18,500	1,500	....	1,125,000	2,000
1877	22,000	1,500	....	1,800,000	3,000
1878	20,000	1,600	....	1,900,000	3,300
1879	20,000	1,600	....	1,950,000	3,500
1880	20,165	1,400	1,590,000	3,085,000	3,000

The following is a list of arrivals and departures from Derby, including Huntington Landing or Shelton, from July 1, 1880, to June 30, 1881:

100 vessels with coal, 21,921 tons, valued at	$109,605
33 vessels with brick, 2,067,000 tons, valued at	12,400
16 vessels with lumber, 2,100,000 feet, valued at	52,500
39 vessels with miscellaneous goods, valued at	60,000

In addition to the above a small steamboat has run here most of the time as an excursion or pleasure boat, and also in towing vessels.

The steamer Monitor, of about 500 tons, commenced running here the 1st of July, making three round trips per week, and is carrying a large amount of freight both ways. Previously nearly all our manufactured goods were shipped by railroad. If the bar at the mouth of the river were improved so that vessels coming to Derby could enter at any time of the tide, there would be a large increase of business on the river.

C 8.

IMPROVEMENT OF BRIDGEPORT HARBOR, CONNECTICUT.

By act of Congress approved June 14, 1880, $10,000 was appropriated for continuing the improvement of this harbor. With this sum it was proposed to widen the 12-foot channel as far as the available funds would allow.

In accordance with this project proposals for dredging were invited, and the bids received opened August 5, 1880. H. N. & A. J. Beardsley, of Bridgeport, Conn., the lowest bidders, were awarded the contract at the rate of 20 cents per cubic yard for material removed from the channel between Long Island Sound and the inner beacon, and 10 cents per cubic yard for material removed from the channel between the inner beacon and the lower bridge. Work under this contract was commenced

October 28, 1880; suspended for the winter November 30, 1880; resumed June 6, 1881, and completed June 30, 1881. There were removed 21,990 cubic yards of material from the east side of the channel between Long Island Sound and the inner beacon, and 48,713 cubic yards of material from the west side of the channel between the beacon and lower bridge. From the sound to the outer beacon the channel was made 240 feet wide and 12 feet deep at mean low-water, except for a distance of about 400 feet near the sound, where the width was not increased; from the outer beacon to the inner beacon the width was made about 300 feet and the depth 12 feet, and from the inner beacon to the steamboat wharf the width was made 300 feet and the depth 12 feet, except for a distance of about 500 feet opposite Cook's Point, where it was made about 250 feet wide.

By act of Congress approved March 3, 1881, $10,000 was appropriated for continuing the improvement. With this sum it is proposed to widen and deepen the channel between the inner beacon and the lower bridge, making the depth 12 feet over as large an area as the appropriation will allow. In accordance with this project, proposals for dredging were invited and the bids received opened June 15, 1881. The contract was awarded to H. N. & A. J. Beardsley, of Bridgeport, at the rate of 10 cents per cubic yard for all material removed. Work under this contract may not be commenced before the spring of 1882, owing to engagements of the contractors at other places.

The present project for the improvement of this harbor was adopted in 1871, and contemplated a channel of navigable width, 14 feet deep at mean low-water, from Long Island Sound to the lower bridge, where the depth was from 4 to 6 feet on the bars and 7 to 14 feet in the channel, at an estimated cost for dredging of $138,000. In connection with the dredging, a breakwater from the east shore was designed at an estimated cost of from $360,000 to $566,000, according to the length adopted. In lieu of this a riprap jetty, 1,380 feet long, was built in 1871 and 1872 at a cost of about $35,000. In 1872 the plan for dredging was modified so as to make the depth required, 9 feet at mean low-water. In 1875, a channel 300 feet wide and 9 feet deep having been obtained, the present modification, *i. e.*, to make the channel 12 feet deep, was adopted. This will probably be accomplished with the expenditure of the appropriation of March 3, 1881.

It is claimed by the citizens of Bridgeport that, by reason of the improvements that have thus far been made, the harbor is now largely used as a harbor of refuge, and that frequently the channel is so filled with vessels at anchor, waiting for favorable winds or fair weather, that it is with difficulty that a passage through the fleet can be made by vessels bound to the wharves. Outside of the channel there is a very small area that is available for anchorage, and that only for small or light-draught vessels. A remedy for this would be to widen the channel from the inner beacon to the steamboat wharf. To make it 400 feet wide and 12 feet deep at mean low-water will require the removal of about 155,000 cubic yards of material; to make it 500 feet wide will require the removal of about 318,000 cubic yards, and to make it 600 feet wide will require the removal of about 498,000 cubic yards.

To remove 155,000 cubic yards, at 12 cents per yard, would cost	$18,600
To remove 318,000 cubic yards, at 12 cents per yard, would cost	38,160
To remove 498,000 cubic yards, at 12 cents per yard, would cost	59,760

Should the plan to widen this part of the channel, in accordance with either of the above estimates, be approved, the sum of $10,000 could be profitably expended during the fiscal year ending June 30, 1883.

The following sums have been appropriated since 1860:

March 3, 1871	$20,000
June 10, 1872	40,000
March 3, 1873	30,000
June 23, 1874	20,000
March 3, 1875	15,000
August 14, 1876	10,000
June 18, 1878	10,000
March 3, 1879	10,000
June 14, 1880	10,000
March 3, 1881	10,000
Total	175,000

One hundred and thirty thousand dollars was expended for excavating and removing 726,093 cubic yards of material, and $35,000 for 13,447 tons of riprap stone for the jetty.

Bridgeport is in the Fairfield collection district, and is the port of entry. The nearest light-house is at the entrance of the harbor, and the nearest work of defense is Fort Hale, New Haven Harbor, 18 miles east.

The amount of revenue collected during the fiscal year ending June 30, 1881, was $5,186.

Money statement.

July 1, 1880, amount available	$10,031 30	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$20,031 30
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		9,947 19
July 1, 1881, amount available		10,084 11

Abstract of proposals received and opened August 5, 1880, *for the improvement of Bridgeport Harbor, Connecticut; dredging.*

Name and address of bidder.	Price per cubic yard.		To commence.	To complete.
	Below the inner beacon.	Above the inner beacon.		
William Flannery, New York, N. Y	$0 18	$0 15½	No date given.	June 30, 1881
John M. Seward, Albany, N. Y	18½	12	....do	June 30, 1881
McDermott & Daly, Cohoes, N. Y	18	12	....do	June 30, 1881
H. N. & A. J. Beardsley, Bridgeport, Conn	20	10	....do	June 30, 1881

Abstract of proposals received and opened June 15, 1881, *for the improvement of Bridgeport, Harbor, Connecticut.*

Name and address of bidder.	Price per cubic yard for dredging.	To commence.	To complete.
H. N. & A. J. Beardsley, Bridgeport, Conn	$0 10	March 1, 1882.	June 30, 1882
Frank Pidgeon, jr., Philadelphia, Pa	14	March 1, 1882.	June 30, 1882
C. M. Pratt, New York, N.Y	14	No date given.	June 30, 1882
John McDermott, Cohoes, N. Y	15	....do	June 30, 1882
J. H. Fenner, Jersey City, N. J	18	July 15, 1881.	June 30, 1882

Abstract of contract for the improvement of Bridgeport Harbor, Connecticut, in force during the fiscal year ending June 30, 1881.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard. Above the inner beacon.	Price per cubic yard. Below the inner beacon.	Remarks.
H. N. & A. J. Beardsley, Bridgeport Conn.	Sept. 27, 1880	Dredging...	$0 10	$0 20	Completed June 30 1881.

COMMERCIAL STATISTICS.

Approximate amounts of material received and shipped by the Bridgeport Steamboat Company between Bridgeport, Conn., and New York, for ten years, ending December, 1880. *From January* 1, 1871, *to December* 31, 1880.

Years.	Manufactured goods and general merchandise.	Pig-iron and other iron.	Rags, paper-stock, &c.	Rubber.	Cotton.	Copper.
	*Tons.**	*Tons.**	*Tons.**	*Pounds.*	*Tons.**	*Tons.**
1871	80, 362	3, 000	15, 500	5, 178, 900	2, 500	12, 500
1872	75, 673	2, 500	18, 650	5, 460, 800	2, 550	10, 900
1873	85, 178	2, 900	16, 250	5, 920, 160	3, 080	11, 200
1874	72, 322	3, 850	18, 200	5, 740, 760	2, 080	9, 850
1875	62, 170	2, 390	16, 800	4, 617, 960	2, 460	10, 850
1876	62, 057	3, 500	15, 800	5, 104, 170	2, 900	9, 700
1877	64, 917	3, 150	19, 600	5, 643, 100	2, 180	11, 200
1878	64, 390	2, 990	17, 180	5, 550, 290	2, 090	9, 900
1879	66, 100	4, 950	19, 400	5, 353, 550	1, 800	10, 300
1880	62, 539	5, 080	18, 900	8, 860, 910	2, 090	12, 400

* Of 2, 000 pounds.

Approximate amount of materials received and shipped at the wharves of the Housatonic Railroad Company, Bridgeport, Conn., during the eight years ending June 30, 1880.

Years.	Coal.	Iron.	Rags and paper waste.	Lumber.	Grain.	Marble.
	Tons.	*Pounds.*	*Pounds.*	*Feet.*	*Bushels.*	*Tons.*
1871						
1872						
1873	13, 626	3, 812, 000		236, 500	1, 600	1, 176
1874	12, 690	8, 284, 000		53, 655		1, 758
1875	14, 316	7, 998, 000	114, 100	718, 670		12, 218
1876	15, 143	9, 284, 000		336, 705		11, 276
1877	19, 267	5, 058, 000		234, 635		6, 136
1878	12, 419	5, 176, 000		813, 310		7, 188
1879	20, 126	11, 244, 000	1, 452, 300	570, 909		8, 031
1880	13, 645	11, 180, 000		83, 480		3, 304
Totals	121, 232	62, 036, 000	1, 566, 400	2, 547, 864	1, 600	51, 087

In addition to the above, there is another daily line of steamers to New York. No account of the business of their line has been received, nor of that done by local or transient vessels.

I am indebted to J. S. Harrover, collector of port at Bridgeport, for the following statistics for the fiscal year ending June 30, 1881:

Collections:

Duties on imports	$1,591 38
Tonnage dues	320 40
Hospital tax	1,619 82
Miscellaneous receipts	1,654 40
Total	5,186 00

Number of foreign vessels arrived from foreign ports	22
Number of foreign vessels cleared for foreign ports	20
Number of American vessels arrived from foreign ports	5
Number of American vessels cleared for foreign ports	0
Number of vessels of all classes entered and cleared during the year*	7,697
Total tonnage	2,120,327
Estimated value of cargoes received	$35,500,000
Estimated value of cargoes shipped	$36,000,000
Number of vessels of all classes entering the harbor of refuge during the year	500

C 9.

IMPROVEMENT OF SOUTHPORT HARBOR, CONNECTICUT.

By act of Congress approved June 14, 1880, $2,500 was appropriated for continuing the improvement of this harbor. Proposals were invited by advertisement and were opened August 5, 1880, for dredging in the harbor from the end of the breakwater to the village.

A contract was made with John M. Seward, of Albany, N. Y., the lowest bidder, who attempted a beginning in October, but on account of drought and consequent difficulty in obtaining fresh water was obliged to stop before making any progress. Work was resumed actively March 21, and completed April 29, 1881, with the removal of 11,294 cubic yards. The channel was made 50 feet wide and 4 feet deep at mean low-water from the outer end of the breakwater to within 400 feet of the wharves.

The sum of $2,500 was appropriated for the furtherance of this work, by act of Congress approved March 3, 1881, which is to be expended in widening the 4-foot channel outside the breakwater to 100 feet or as near that width as may be. Advertisements were issued and proposals for doing the work were opened June 15, 1881. The only bid received was from John McDermott, of Cohoes, N. Y., with whom a contract will be entered into.

The following sums have been appropriated by Congress for the improvement of this harbor, since 1838, viz:

March 3, 1875	$5,000
August 14, 1876	5,000
June 14, 1880	2,500
March 3, 1881	2,500

Under the first two of these appropriations the breakwater built in 1832 was repaired and covered with a coping of heavy stone; a fence was built to arrest the motion of sand above high-water mark; the dike built in 1838 was repaired, and a channel, 60 feet wide and 4 feet deep at mean low-water, was dredged from Long Island Sound to the end of the breakwater. The expenditure of the appropriation of 1880 and the proposed work for 1881 are described in detail above.

The effect of the work already done in Southport Harbor has been greatly to the advantage of its navigation interests, and it is believed that with $3,000 more the improvement of the harbor can be completed as far as the needs of its commerce or the wishes of the people seem to require. It is therefore recommended that this sum be asked for, for the ensuing year.

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* Estimated.

Southport is in the Fairfield collection district, of which Bridgeport is the port of entry. The amount of revenue collected there for the fiscal year ending June 30, 1881, was $5,186.

The nearest light-house is on Penfield Reef, 3¼ miles from the harbor. Fort Hale, New Haven Harbor, the nearest work of defense, is 24 miles distant.

I am indebted to Mr. John H. Perry, of Southport, Conn., for the following statistics of the commerce of the harbor during the past year. No records of the commerce of previous years have been kept, and I have been unable to obtain estimates of any value for comparison.

Received:	
Tons of coal	3,500
Feet of lumber	400,000
Bushels of grain	300,000
Tons of general merchandise	5,000
Shipped:	
Tons of general merchandise	9,000
Sailing-vessels, arriving and departing	800
Barges in tow, arriving and departing	100

Money statement.

July 1, 1880, amount available	$2,521 60	
Amount appropriated by act approved March 3, 1881	2,500 00	
		$5,021 60
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,510 18
July 1, 1881, amount available		2,511 42
Amount (estimated) required for completion of existing project		3,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		3,000 00

Abstract of proposals opened August 5, 1880, for the improvement of Southport Harbor, Connecticut.

Name and address of bidder.	Price per cubic yard.	To commence.	To complete.	Amount that could be removed.
				Cubic yds.
William Flannery, New York	$0 22	No date	June 30, 1881	9,760
McDermott & Daly, Cohoes, N. Y	28	....do	June 30, 1881	7,670
John M. Seward, Albany, N. Y	19	....do	June 30, 1881	11,300

Abstract of proposals opened June 15, 1881, for the improvement of Southport Harbor, Connecticut.

Name and address of bidder.	Price per cubic yard.	To commence.	To complete.
John McDermott, Cohoes, N. Y	$0 33	No date	June 30, 1882

Abstract of contract for the improvement of Southport Harbor, Connecticut, in force during the fiscal year ending June 30, 1881.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard.	Remarks.
John M. Seward, Albany, N. Y.	Sept. 1, 1880.	Dredging	$0 19	Completed April 29, 1881.

C 10.

IMPROVEMENT OF NORWALK HARBOR, CONNECTICUT.

By the terms of an act of Congress, approved June 14, 1880, appropriating $5,000 for the improvement of Norwalk Harbor, as much of the appropriation as should be necessary was to be expended in making the channel 6 feet deep at low-water between the steamboat landing and Long Island Sound. As this depth at mean low-water had already been obtained for a channel 100 feet wide, the obvious interpretation seemed to be 6 feet deep at extreme low-water, which would be about 8 feet at mean low-water, and a project modified in this manner was submitted and approved.

Proposals were advertised for, and opened August 5, 1880, and a contract entered into with Messrs. H. N. & A. J. Beardsley, of Bridgeport, Conn., who began the work September 21, and completed it October 21, 1880, removing 38,083 cubic yards of mud from the east side of the channel at and below the upper turn of the cross-over below the wharves at South Norwalk. The channel was thus made about 100 feet wide and 8 feet deep at mean low-water over a total length of 2,200 feet. The material dredged was carried out and dumped in deep water in Long Island Sound to the southeast of Goose Island.

By act of Congress approved March 3, 1881, the further sum of $5,000 was appropriated for this improvement. This it is proposed to expend in widening the lower turn of the cross-over below the South Norwalk wharves, and in removing certain shoals that have formed in the river during winter and spring by the action of ice, or in doing so much of this work as the funds will admit of. The principal places where shoaling has occurred are at Squirrel Flats, about 900 feet above the railroad bridge, and at and just above Ferry's Point. The material of which these shoals are formed is mainly mud, whereas that brought down by the river is generally gravel and sand. It seems very probable that this mud is pressed into the channel by the weight of ice in winter on the surrounding flats, which are bare at low-water. After duly advertising, proposals for doing this work were opened June 15, 1881, and a contract will be made with Mr. Frank Pidgeon, jr., of Philadelphia, Pa., he being the lowest bidder.

According to the estimate submitted with the last annual report, the further amount required to complete this channel would be $15,000. It is probable that future modifications of this estimate will be found to be necessary, principally owing to the changes produced by freshets and to the increased depth given to the channel below the railroad bridge.

The following sums have been appropriated for improving this harbor:

June 10, 1872	$10,000
March 3, 1873	10,000
June 23, 1874	10,000
March 3, 1875	7,000
June 18, 1878	6,000
March 3, 1879	10,000
June 14, 1880	5,000
March 3, 1881	5,000
Total	63,000

Norwalk is in the Fairfield collection district. Bridgeport is the nearest port of entry, where the amount of revenue collected during the fiscal year ending June 30, 1881, was $5,186.

Norwalk light, on Sheffield Island, is opposite the mouth of the river.

The nearest works of defense are the fortifications at Throg's Neck, 29 miles distant.

Money statement.

July 1, 1880, amount available	$5,043 62	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$10,043 62
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		5,019 09
July 1, 1881, amount available		5,024 53
Amount (estimated) required for completion of existing project		15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		10,000 00

Abstract of proposals opened August 5, 1880, *for the improvement of Norwalk Harbor, Connecticut.*

Name and address of bidder.	Price per cubic yard.		To commence.	To complete.
	Below draw-bridge.	Above draw-bridge.		
H. N. & A. J. Beardsley, Bridgeport, Conn	$0 12	$0 14	No date	June 30, 1881
John M. Seward, Albany, N. Y	13	14	....do	June 30, 1881
William Flannery, New York, N. Y	16	17	....do	June 30, 1881
McDermott & Daly, Cohoes, N. Y	17	17	....do	June 30, 1881

Abstract of proposals opened June 15, 1881, *for the improvement of Norwalk Harbor, Connecticut.*

Name and address of bidder.	Price per cubic yard.		To commence.	To complete.
	Below draw-bridge.	Above draw-bridge.		
John McDermott, Cohoes, N. Y	$0 17	$0 17	No date	June 30, 1882
J. H. Fenner, Jersey City, N. J	18	18	....do	June 30, 1882
H. N. & A. J. Beardsley, Bridgeport, Conn	16½	16½	....do	June 30, 1882
Frank Pidgeon, jr., Philadelphia, Pa	15	17	Mar. 1, 1882.	June 30, 1882

Abstract of contract for the improvement of Norwalk Harbor, Connecticut, in force during the fiscal year ending June 30, 1881.

Name and address of contractor.	Price per cubic yard.		Subject of contract.	Date of contract.	Remarks.
	Below draw-bridge.	Above draw-bridge.			
H. N. & A. J. Beardsley, Bridgeport, Conn.	$0 12	$0 14	Dredging...	Sept. 27, 1880.	Contract completed Oct. 21, 1880.

COMMERCIAL STATISTICS.

Approximate amount of material received and shipped by way of Norwalk River, for the ten years ending June 30, 1880.

	Year ending June 30—									
	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880
Received:										
Coal..............tons..	73,900	74,000	75,000	75,500	76,000	77,000	78,000	76,000	76,000	78,000
Iron................do..	3,000	3,000	3,500	3,200	3,400	3,600	3,400	3,500	3,450	3,600
Lumber.....1,000 feet..	8,010	9,000	9,000	9,500	10,000	10,000	11,000	12,000	12,000	10,000
General merchandise, tons.	26,805	30,785	31,350	34,160	32,317	36,305	41,700	38,760	36,860	39,100
Shipped:										
Lumber .....1,000 feet..	50	60	75	75	80	90	100	100	125	140
General merchandise, tons.	3,000	3,025	2,725	2,490	2,870	3,070	2,860	2,965	2,565	3,095
Vessels arriving and departing:										
Steamers	489	490	495	500	500	500	510	510	520	540
Sailing-vessels..........	280	280	285	290	300	300	300	310	320	340
Barges	319	320	330	340	350	350	350	360	365	375

C II.

IMPROVEMENT OF PORT JEFFERSON HARBOR, NEW YORK.

The contract for dredging which was in progress at the time of writing the last annual report was completed July 17, 1880, by the removal of 8,000 cubic yards of gravel and sand, making a channel through the entrance to the harbor 100 feet wide and 8 feet deep at mean low-water.

The appropriation of $3,000, made by act of Congress approved June 14, 1880, was to be expended in raising and strengthening the east breakwater at its shore end, and in lengthening the west breakwater as far towards deep water as the means would admit of.

Under this plan proposals duly advertised for were opened August 5, 1880, and subsequently a contract was entered into with James Scully, of Groton, Conn. The contractor was delayed by causes not altogether within his own control, and the first load of stone was not delivered until June 15, 1881. At the close of the fiscal year 1,400 tons of granite had been placed in the breakwaters, and under an extension of the contract to July 10, 1881, 100 tons more were delivered July 1, completing the contract on that date.

The appropriation of $4,000, made by act of Congress approved March 3, 1881, is to be expended in extending the jetties, with a view to protecting and deepening the channel on the outer side of the bar. Proposals were invited by the usual advertisement, and were opened June 15, 1881. All of the bids offered seemed higher than was reasonable, and all were rejected. The work will be readvertised July 1, 1881.

The effect of the work done at Port Jefferson has been to give a depth to the entrance of the harbor of 8 feet at mean low-water, where formerly it had not been over 3 feet at the same stage of tide. Those interested in navigation at that place are naturally much pleased with the result, but would prefer to have the money which is being spent on the jetties used for dredging. These jetties, however, have done much towards scouring out the channel and everything towards preserving its permanency; without them any dredged channel would probably not have lasted a year.

To carry out the jetties to the 9-foot curve, according to estimates submitted in the annual report for 1877, would require $8,000 more. Though the prices have been ruling uniformly higher than could have been expected at that time, yet it is probable that the sum of $8,000 will be sufficient to complete the east jetty, and it is possible that further work on the west jetty may prove unnecessary. It is preferred to make no modification in the estimated amount of money required until the effect of the completed east jetty can be seen; but the appropriation of this sum in one amount cannot be too strongly urged. The action of the waves at this point in Long Island Sound is very violent, and constantly tends to form a bar across the outer end of the entrance channel, so that the longer the completion of the jetty is delayed, the greater is the probability of new obstructions forming. On this account, as well as on account of economy in prices, it is recommended that $8,000 be asked for, for the fiscal year ending June 30, 1883.

The following several amounts have been appropriated by Congress for this work, viz:

Date.	Amount.	Remarks.
March 3, 1871	$15,000	Applied to east jetty.
June 10, 1872	15,000	Do. Do.
March 3, 1875	15,000	Applied to east and west jetties.
August 14, 1876	6,000	Applied to east jetty and dredging.
June 18, 1878	8,000	Applied to both jetties.
March 3, 1879	5,000	Applied to dredging.
June 14, 1880	3,000	Applied to both jetties.
March 3, 1881	4,000	

Port Jefferson is a port of delivery in the New York collection district.

The nearest light-house is on Old Field Point, immediately west of the harbor entrance. Fort Hale, New Haven Harbor, 23 miles distant, is the nearest work of defense.

Money statement.

July 1, 1880, amount available	$4,605 67	
Amount appropriated by act approved March 3, 1881	4,000 00	
		$8,605 67
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,780 93	
July 1, 1881, outstanding liabilities	2,535 00	
		4,315 93
July 1, 1881, amount available		4,289 74
Amount (estimated) required for completion of existing project		8,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		8,000 00

Abstract of proposals opened August 5, 1880, *for the improvement of Port Jefferson Harbor, New York.*

Name and address of bidder.	Price per gross ton.	To commence.	To complete.
James Scully, Groton, Conn	$1 69	No date	June 30, 1881.
John Beattie, Leete's Island, Conn	2 50	....do	June 30, 1881.

Abstract of proposals opened June 15, 1881, *for the improvement of Port Jefferson Harbor, New York.*

Name and address of bidder.	Price per ton.	To commence.	To complete.
John Beattie, Leete's Island, Conn	$2 50	No date	June 30, 1882.
Chauncey D. Allen, Westfield, Conn	2 48	....do	June 30, 1882.

Abstract of contract for improvement of Port Jefferson Harbor, New York, in force during the fiscal year ending June 30, 1881.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per ton.	Remarks.
James Scully, Groton, Conn	Aug. 30, 1880	Riprap granite	$1 69	Extended to July 10, 1881, and completed July 1, 1881.

COMMERCIAL STATISTICS.

Approximate amount of material received in and shipped from Port Jefferson Harbor, Long Island, New York, for the ten years ending June 30, 1881.

	Year ending June 30—									
	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.	1879.	1880.
Received:										
Coal ....tons.	2,000	2,000	2,000	2,500	2,500	4,000	4,300	4,100	2,000	4,500
Lumber ......1,000 feet.	400	400	450	450	500	500	520	550	600	450
General merchandise, tons.	3,210	3,280	3,130	3,325	3,530	3,890	3,270	2,775	4,400	5,220
Shipped:										
Wood ....cords.	1,500	1,800	1,500	1,500	1,600	1,600	1,800	2,000	2,000	2,205
General merchandise, tons.	115	225	245	230	290	325	228	230	377	590
Tonnage of vessels built	1,500	1,000	1,200	1,700	1,800	1,400	1,600	1,800	4,000	1,500
Vessels arriving and departing:										
Steamers	20	20	300	320	360	360	400	430	450	410
Sailing-vessels	900	900	900	950	950	950	970	990	1,000	1,000
Barges	3	3	2	6	4	2	0	5	2	1

C 12.

SURVEY WITH A VIEW TO OPENING CHANNEL BETWEEN LLOYD'S HARBOR AND COLD SPRING BAY, NEW YORK.

ENGINEER OFFICE, UNITED STATES ARMY,
New London, Conn., December 24, 1880.

GENERAL: I have the honor to submit the following report of survey for opening channel between Lloyd's Harbor and Cold Spring Bay, New York, authorized by section second of the river and harbor act approved June 14, 1880.

This work was assigned to my charge June 17, 1880, and as soon as practicable after learning something of the nature of the desired improvement, I organized a field party consisting of Mr. William W. Starr, jr., assistant engineer, George K. McEwen, and Oscar Darling, civil engineers, with necessary boatmen, to make an instrumental examination of the locality.

The object of the examination was to ascertain the amount of material necessary to be removed to create a navigable channel between the two harbors; the rise and fall of the tide in each, with a view to determining the probability of a tidal current being produced through the new channel. The work was in progress from the 6th of September until the 10th, tidal observations being afterwards continued during one-half a lunation. Owing to bad weather the soundings were not carried over as large an area as was intended, but sufficient work was accomplished upon which to base satisfactory estimates of cost.

A map showing the area examined and a copy of Coast Survey chart of the two harbors and adjoining county are sent herewith.

A statement of Mr. Oscar Darling, civil engineer, a resident of Huntington, and who assisted in the survey, accompanies this report.* Mr. Darling's statement is given in full, as it is believed to embody the views of the citizens of Huntington and other towns who are interested in the accomplishment of the improvement.

The object of the proposed channel is to afford communication between New York City and the villages of Huntington, Centreport and Northport, by a route more direct, saving 2 miles in distance and avoiding the exposed headland and shoals now encountered in rounding Lloyd's Point.

It is also claimed that the use of Lloyd's Harbor for refuge would be increased. It is not probable, however, that this would occur to any great extent, as that harbor is now easily accessible from the eastward, and Oyster Bay affords safe anchorage for vessels seeking shelter from the westward.

Lloyd's Harbor is a shallow estuary extending from Huntington Bay westward a distance of about 3 miles, reaching to within a few rods of Oyster Bay, and nearly severing the promontory of Lloyd's Neck from the main land of Long Island.

The waters of the two bays were originally connected, and Lloyd's Neck was an island.

The action of the waves and tides has caused the opening into Oyster Bay to become closed, by a firm sand beach, along which a highway has been constructed leading over to the farming lands on Lloyd's Neck.

The shore on the Cold Spring side of the beach is bold and the water deep, the tide ebbing and flowing in a current parallel to it. On the opposite side is the extreme head of Lloyd's Harbor, bare at low-water for a long distance from the beach and having an average depth of but 4 feet at low-water for a distance of about 3 miles.

The improvement contemplated must consist in dredging a channel through the sand beach, and also through Lloyd's Harbor, a greater or less distance, depending upon the depth of channel sought.

To make the channel permanent, *i. e.*, to prevent a renewal of the sand beach from the same causes which originated it, one or, perhaps, two jetties will be necessary at the opening on the Cold Spring shore.

A draw-bridge, where the highway will cross the channel, will also be required.

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*Omitted. Printed in House Ex. Doc. No. 31, Forty-sixth Congress, third session.

The tidal observations indicate but a slight difference either in the rise and fall at the two harbors, or in the time of their periods. Therefore but little tidal current can be expected to aid in keeping the channel clear. Except the tendency to close the channel at the cutting through the beach by the action of the tides and waves in Cold Spring Bay, there seems to be no cause to apprehend a serious shoaling of the channel when once completed.

I have been unable to obtain positive information as to the width and depth of channel needed; but, assuming that sailing-vessels of draught as great as 10 feet will be likely to use it, and that a line of steamers between New York and Huntington is contemplated, the depth should be made 10 feet at low-water, and the width not less than 200 feet, except at the crossing of the highway, where a draw-bridge should be constructed leaving a clear passage-way between the abutments of 75 feet. Following are estimates of the cost of improvement for a channel 200 feet wide and 10 feet deep at mean low-water:

DREDGING.

Amount of material necessary to be removed, following the line of the natural channel, 1,049,700 cubic yards, at 20 cents	$209,940 00
(Along the most direct line the amount would be 86,500 cubic yards less.)	

DRAW-BRIDGE.

Iron bridge to turn on one of the abutments, with a clear opening of 75 feet	4,000 00

ABUTMENTS AND WING-WALLS.

1,806 cubic yards of dimension stone, at $12 per yard	21,672 00
One jetty on north side of opening into Cold Spring Bay, 3,200 tons of rip-rap, at $1.25	4,000 00
Contingencies; 20 per cent	47,922 40
	287,534 40

Should the width of the channel be reduced to 100 feet, and wood substituted for iron in the construction of the bridge, the estimate could be reduced about one-third.

I am indebted to the Hon. James W. Covert for the following information and statistics relating to the village of Huntington, Long Island.

Very respectfully, your obedient servant,

J. W. BARLOW,
Major of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

COMMERCIAL STATISTICS.

Population of Huntington village, including union school district	3,000
Number of stores	30
Markets	3
Manufactures: earthenware, carriages, sash and blinds, row-locks, &c	11
Churches	8
Schools, 1 union school; attendance	500
Value of property, real and personal, on assessor's books	$2,500,000
Vessels from Huntington Harbor:	
Packets in city trade, regular	3
Vessels freighting	15
Vessels freighting, transient	20
Tons of merchandise received at port yearly	15,000
Tons of other freight received at port yearly	23,000
Tons of freight going from port yearly	25,000
Estimate of number of vessels visiting Huntington Bay and Lloyd's Harbor yearly for purpose of shelter during storms, &c.	5,000

APPENDIX D.

IMPROVEMENT OF HUDSON RIVER—REMOVAL OF OBSTRUCTIONS IN EAST RIVER AND HELL GATE—IMPROVEMENT OF BUTTERMILK CHANNEL, NEW YORK HARBOR; OF FLUSHING, CANARSIE, SHEEPSHEAD, AND GOWANUS BAYS, AND SUMPAWAMUS INLET; OF HARLEM RIVER; NEWTOWN AND EAST CHESTER CREEKS; THE HARBORS OF RONDOUT, ECHO, PORT CHESTER, AND NEW ROCHELLE, NEW YORK, AND OF RARITAN AND SOUTH RIVERS, AND CHEESEQUAKES CREEK, NEW JERSEY.

REPORT OF COLONEL JOHN NEWTON, CORPS OF ENGINEERS, BVT. MAJ. GEN., U. S. A., OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1881, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

UNITED STATES ENGINEER OFFICE,
New York, *July* 25, 1881.

SIR: I have the honor to transmit herewith the annual reports upon the river and harbor works in my charge for the fiscal year ending June 30, 1881.

Very respectfully, your obedient servant,

JOHN NEWTON,
Colonel of Engineers,
Bvt. Major-General.

The CHIEF OF ENGINEERS, *U. S. A.*

D 1.

IMPROVEMENT OF HUDSON RIVER, NEW YORK.

First Lieut. J. H. Willard, Corps of Engineers, serving under the orders of the engineer in charge, and placed in superintendence of the construction of works of improvement of this river, was relieved from this duty by Special Orders No. 255, headquarters of the Army, Adjutant-General's Office, December 1, 1880.

The value of his efficient and faithful services it is proper to acknowledge here.

The project for improving the river was adopted in 1867, and was modified in 1868, the object being to afford a navigable channel of 11 feet in depth at mean low-water and of 9 feet to Troy.

The system was by longitudinal dikes to guide the currents and to define the channel, preserving as far as possible the tidal basins. The dikes were low, not higher, as a rule, than the level of mean high-water—limited to that height to permit a free discharge both of freshets and of floating ice over the top of the dikes.

The dikes are constructed of two rows of piles driven into the bed of the river and filled with stone. This mode of construction has been found the most suitable, as it confines the stone filling, which, without it, would be soon swept away by the ice and by the waves of the large steamers, which, in fact, are formidable waves of translation.

During the past year the following work has been done:

Round timber has been put on the single rows of piling at Patroon's Island, Cedar Hill, the Overslaugh, Cow Island, at Staats, Shad Island, and Bear Island.

The line of single piling at upper section, at Staats, has been extended for a length of 225 feet southwards.

Repairs were made to dikes at Bath and Douw's Point. Rubble-stone has been placed along the single row of piling at the following places:

	Cubic yards.
Cedar Hill	1, 046$\frac{1}{3}$
Cow Island and cross-dike	2, 566$\frac{6}{27}$
Staats, upper section	3, 856$\frac{19}{27}$
Staats, lower section	687$\frac{23}{27}$
Bear Island	1, 193

The early and sudden closing of navigation prevented the protection designed for the single piling, by depositing rubble-stone along the line, from being fully carried out.

The unusually heavy ice, said to be several feet in thickness, which formed in the winter around the piles, and acted upon by the daily rise and fall of tides, succeeded in lifting up some of the piles and in sundering also the fastenings of the waling strips. When the ice broke up in the spring the dislodged piles were sent adrift. Most of them were, however, recovered, and are now in store ready for redriving.

The total length of the lines of single piles driven was about 21,416 feet, and the lengths dislodged about 5,459 feet, or 25 per cent. As the piles dislodged are reported to have been situated where rubble had not been deposited at all, or in incomplete quantities, and as the piles have been mostly recovered, it is highly probable that the damage will not exceed $3,000.

Some of the piles, also, which had been raised by the action of the ice slightly above the level at which they had been driven, were tapped by the ram of the pile-driver and thus restored to their position.

The extent of the restoration was at—

Staats	1,100 feet in length.
Bear Island	60 feet in length.
Cedar Hill	10 feet in length.

Fourteen oak fender piles were placed along the face of the dike at Cedar Hill, to keep the guards of the boats off from the piles.

The project of operations for the fiscal year ending June 30, 1882, is to restore the lines of piling wherever considered necessary and to reinforce them with rubble at the base, according to the original design.

To repair the wood-work and supply stone in certain of the dikes.

To remove, by blasting and dredging, the reefs known under the general name of Austin's Rock, near Van Wies' Point.

The map sent herewith represents the progress of the diking system, but not the present depths of water.

1. The original condition of the navigable channel gave, between New Baltimore and Barren Island, a depth at mean low-water of 7½ feet; at Coeymans, 8½ feet; at Mulls, 9 feet; at Castleton, 8 feet; at Cedar Hill, 7½ feet; at Winnies, 9.4 feet; on the Overslaugh, 7.7 feet; at Cuyler's Bar, 9 feet; at Round Shoal, 7.2 feet. That is, at low-water 7½ feet could be carried from New Baltimore to Albany, and from Albany to Troy, 7.2 feet.

D A C
and
Island
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EYMANS

The channels, however, were very crooked in places, very narrow, and of such difficult navigation that the grounding of boats was, it might almost be said, the rule and not the exception.

2. The originally adopted project for the improvement was the construction of longitudinal dikes, generally of the height of mean high-water, to direct the currents and allow the flow over their top of freshets and of ice.

3. The amount expended therein to the close of the fiscal year ending June 30, 1880, was $881,441.14.

4. The condition of the improvement at that period, was a navigable depth from New Baltimore to Albany at mean low-water of 9½ feet, and from Albany to Troy of 8 feet, as reported by Lieut. J. H. Willard, Corps of Engineers.

5. During the year ending June 30, 1881, there has been expended $18,718.02. The results in the way of increased depth and facilities for navigation are not known, for want of a recent survey.

6. The amount that can be profitably expended during the year ending June 30, 1882, is the available balance, $54,128.84, and this amount will be devoted to the removal of Austin's Rock and the restoration and repair of lines of piles and of dikes.

The benefits to be expected will be a greater width and depth of navigable channel and a relief from being wrecked and sunk upon rocky reefs.

7. The estimated amount required for the entire and permanent completion of the work of improvement, in accordance with the approved and adopted project, is $30,000.

This work is in the collection district of New York, Albany being a port of delivery. The value of the imports for the fiscal year ending June 30, 1881, was $681,891.20, and the duties collected on the same were $137,204.48.

There are enrolled and licensed at this port 767 vessels, with a tonnage of 90,860.01.

AMOUNTS APPROPRIATED.

By act approved June 23, 1866	$50,000 00
By act approved March 3, 1867	305,188 00
By act approved July 25, 1868	85,000 00
By act approved April 10, 1869	89,100 00
By act approved July 11, 1870	40,000 00
By act approved March 3, 1871	40,000 00
By act approved June 10, 1872	40,000 00
By act approved March 3, 1873	40,000 00
By act approved June 23, 1874	40,000 00
By act approved March 3, 1875	40,000 00
By act approved August 14, 1876	50,000 00
By act approved June 18, 1878	70,000 00
By act approved March 3, 1879	30,000 00
By act approved June 14, 1880	20,000 00
By act approved March 3, 1881	15,000 00
	954,288 00
Amount expended	900,159 16

Money Statement.

July 1, 1880, amount available	$57,935 89	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$72,935 89
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		18,718 02
July 1, 1881, amount available		54,217 87
Amount (estimated) required for completion of existing project		30,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		30,000 00

D 2.

IMPROVEMENT OF HARBOR AT RONDOUT, NEW YORK.

In the last annual report a full history of this improvement, which has virtually arrived at completion, was given.

The least depth in the channel before undertaking the improvement was 7 feet at mean low-water; in 1879, the date of the last survey, it was 13½ feet.

The last annual report states—

> As the result of the works of improvement, there is now a channel 50 feet wide, giving 13½ feet at mean low-water; 100 feet wide, giving 12 feet at mean low-water; and about 200 feet wide, giving 10 feet at mean low-water from the creek to the channel of Hudson River. At the outer end of the dikes the distance between the 12-foot curves is over 300 feet.

Notwithstanding this great width of deep channel at the outlet, there has been a desire manifested of obtaining there more room for the swinging of the tows under conditions of wind and tide, and it has been proposed to do away with the shoal along the south dike near its extremity.

In the last annual report it is said:

> This shoal is a natural result of the circumstances which existed at the place and was clearly foreseen. Recent observations, however, give the hope of ameliorating considerably the conditions which have led to its formation. It has been found that the waters of the flood-tide are banked up above the normal level in the space south of the south dike, and then escaping with force at the extreme end of this dike, deflect the flood currents entering the creek.

Such was the report made by the surveyor who examined the matter; but upon an inspection made by the engineer in charge during the past fiscal year, it was very evident that there was no banking up of the flood, and that the diminution of the shoal must be determined from other considerations.

It is considered likely that the outlet would be widened from the wearing away of the outer shoal, caused by removing the end of the south dike for a length of 100 or 200 feet.

1. The original condition of the navigable channel gave a depth of about 7 feet at mean low-water.

2. The originally-adopted project was the prolongation of the channel of Rondout Creek into the Hudson River by the construction of two parallel dikes; also of a branch dike to direct the current of the river and to protect the north dike from the floating ice; and there has been no modification of the original project.

3. The amount expended to June 30, 1880, was $88,294.65.

4. And at that time the depth in the channel was 13½ feet at mean low-water.

5. There has been expended during the year ending June 30, 1881, for incidental purposes only, the sum of $344.16, without effect upon navigation.

6. The sum that can be profitably expended during the fiscal year ending June 30, 1882, is the available balance of $2,361.19 for repairs to dikes arising from collisions of vessels, &c., and upon the removal of a portion of the south dike at its extremity.

7. The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project would be, at most, $1,000 to $2,000, to be used in removing any portion deemed necessary of the extremity of the south dike.

The original estimate was	$172,500 00
There have been expended	88,638 81

This work is in the collection district of New York; nearest port of entry, New York. Amount of revenue collected during the fiscal year ending June 30, 1881, $139,579,562.83. Amount of commerce and navigation benefited by the completion of this work, $70,000,000.

ORIGINAL ESTIMATE.

North dike	$41,600 00
Branch dike	34,400 00
South dike	59,600 00
Dredging channel	14,400 00
Contingencies and engineering	22,500 00
Total	172,500 00

AMOUNTS APPROPRIATED.

By act approved June 10, 1872	$10,000 00
By act approved March 3, 1873	20,000 00
Amount allotted June 8, 1875:	
From repairs of harbors on Atlantic coast	762 18
From contingencies of rivers and harbors, &c	237 82
By act approved August 14, 1876	30,000 00
By act approved June 18, 1878	30,000 00
	91,000 00

Money statement.

July 1, 1880, amount available	$2,705 35
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	344 16
July 1, 1881, amount available	2,361 19
Amount (estimated) required for completion of existing project	2,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	2,000 00

D 3.

REMOVING OBSTRUCTIONS IN EAST RIVER AND HELL GATE, NEW YORK.

The full project for this improvement, as made in 1867, has been since approved by parts from year to year, with the addition to the original project made for Hell Gate, of the removal of reefs in the East River, viz, Diamond Reef, Coenties Reef, and of a reef at the North Brother.

Capt. James Mercur, Corps of Engineers, continued in superintendence of the removal of rock from Hallet's Point Reef, of the excavations at Flood Rock, Hell Gate, and of the work of the steam drilling scow in East River and Hell Gate until June 14, 1881, having been relieved from duty under the orders of General Newton, by Special Orders No. 120, Adjutant-General's Office, May 26, 1881, and it is proper here to acknowledge the thorough skill and efficiency with which he performed the numerous and important duties confided to him.

REEF AT HALLET'S POINT.

The operations here have been the continuance of grappling and removing the *débris* from the explosion in 1876.

During the fiscal year there have been removed 9,823.77 gross tons of broken stone, under the contract with the Atlantic Dredging Company.

The total amount of stone removed from this reef since the explosion is 81,907.84 gross tons.

The contract with the Atlantic Dredging Company has been extended to January 1, 1882.

The full depth of 26 feet at mean low-water has been attained for an area bounded by the northeast edge of the reef and a line parallel therewith, and 250 feet distant from it; this includes about two-thirds of the reef; over the remaining one-third there are still shoal points having 19 to 20 feet over them at mean low-water.

FLOOD ROCK.

During the year the work has been carried on continuously; the length of galleries driven has been 7,312 linear feet, and the number of cubic yards of stone in place removed 18,080.

The work for the year has been entirely in headings, without enlargements. The length of galleries to June 30, 1880, was 6,211.08 linear feet, and the stone removed measured in place amounted to 21,528.38 cubic yards.

Total length of galleries June 30, 1881, was 13,523.08 linear feet, and total number of cubic yards in place removed 39,608.38.

The work of excavating now proceeds almost as rapidly as it is possible to push it, with due regard to economy, and it is probable that it will require nearly two years to complete the excavations preparatory to the final explosion.

The area already covered by the excavations amounts to 4.844 acres.

As the galleries extended to greater distances from the shaft it became necessary to provide means of ventilation, and for this object a ventilating fan 12 feet in diameter, driven by a 12″ × 18″ vertical engine, was, under the superintendence of Captain Mercur, placed at the opening to the shaft; the object of the fan being to exhaust the air from the galleries, discharging the foul air about 20 feet above the level of the rock, while the fresh air should descend by way of the shaft. Eight new Ingersoll drills have been provided and set to work during the year as fast as the progress made developed new points for working.

The large number of drills and the variety of other machinery to be kept in repair made it necessary to increase the facilities of the machine-shop, and for this purpose an engine lathe, 20 inches swing and 12 feet bed, was purchased and put in operation.

Captain Mercur gave his personal attention to providing the proper machinery and appliances for excavating and removing the rock.

For further information concerning the amount and other details of the work done during the fiscal year at Flood Rock reference is respectfully made to the subjoined table, marked A.

A sketch showing the progress of the excavation to the close of the year ending June 30, 1880, and June 30, 1881, is transmitted herewith.

During the fiscal year ending June 30, 1882, the same system of excavations at Flood Rock will be pursued, and it is supposed that the progress will be even greater than for the past year.

OPERATIONS WITH STEAM-DRILLING SCOW.

At the beginning of the fiscal year it was found necessary to make some repairs to the hull and machinery of the drilling scow. This was completed by August 10, 1880. The scow was then placed upon Heel Tap Rock in Hell Gate, and by surface blasting and drilling the reef was reduced at the close of operations, December 21, to 20 feet at mean low-water.

While the scow was in winter quarters a new bridge for the drill carriages was put up, machinery overhauled and repaired.

In April, 1881, a grapple was put to work on Heel Tap Rock and removed the rock broken by the drilling scow in the previous fall, 195.04 cubic yards being taken up.

From May 17 to June 20 the scow was again at work on Heel Tap Rock,

and during that time broke up the reef to the proper depth, as supposed. After the grapple has removed the broken stone it will be determined whether it will be necessary to send the scow back.

On June 20 the scow was placed upon the reef near the North Brother Island. Reference is respectfully made to the subjoined report of General Roy Stone, assistant engineer, marked B.

It is probable that the Heel Tap Rock and the rock near the North Brother will be removed before December next, and it is proposed to begin in the spring the removal of Frying Pan at Hell Gate.

1. The original condition of the channel of East River and Hell Gate was the existence of many large and dangerous rocky obstructions to navigation. The depth over Diamond Reef at mean low-water was 17½ feet; over Coenties Reef, 14.3 feet; over Frying Pan, 11 feet; over Pot Rock, 20 feet; over Heel Tap, 12.1 feet; over reef at the North Brother 16 feet. Hallet's Point, from the shore at Astoria, projected under water 325 feet to the contour line of 26 feet at mean low-water, and embraced an area of about 3 acres. The Middle Reef, with an area of about 9 acres, lay in the middle of the channels at Hell Gate, having a small backbone projecting above high-water, and caught vessels swept upon it by the ebb currents which passed directly over the rock. Hallet's Point and the Middle Reef may be said to have been alternate in mischievous functions; vessels which escaped one ran a great risk of falling upon the other. What added considerably to the danger from these reefs was the bend at right angles of the river at the spot.

2. The originally-adopted project for the improvement was the least extensive of three projects discussed by the engineer in charge. That one now being carried out was judged by the authorities in 1867 to be too extensive and costly. The project first adopted was the removal of Pot Rock, Frying Pan, Way's Reef, Shelldrake, the rock off Negro Point, the rocks near Woolsey's bath-house, Blackwell's Rock, portions of Hallet's Point and of Scaly Rock. Sea-walls were designed for the Middle Reef, Hog's Back, the Bread and Cheese, and a beacon for Rylander's Reef.

The project most favored by the engineer in charge, which included likewise the total removal of Hallet's Point and of the Middle Reef, has, as time passed, received the approval of the authorities.

The project first intended solely for Hell Gate has also been modified by incorporating with it rocky obstructions in the East River, Diamond Reef, Coenties Reef, and a reef near the North Brothers.

3. The amount expended thereon to the close of the fiscal year ending June 30, 1880, was $2,359,280.57.

4. The condition of the improvement was the removal of Diamond, Coenties, Way's Reef, and Shelldrake to the depth of 26 feet at mean low-water, the tunneling and explosion of Hallet's Point, and the removal of a large portion of the *débris* with a least depth over any portion of 17 feet at mean low-water, the tunneling of the Middle Reef (Flood Rock) to the extent of 6,211.08 linear feet, and the removal therefrom of 21,529.38 cubic yards of stone measured in place. The "Bread and Cheese," a dangerous reef, had been inclosed and embanked by Commissioners of Charities and Correction of New York City.

5. The amount expended during the year ending June 30, 1881, was $256,981.47.

The area off Hallet's Point, which has been brought to the depth of 26 feet at mean low-water, is about two-thirds of the whole area, and double of what it was on June 30, 1880; the least depth on the remaining portion not removed to full depth is 19 feet at mean low-water; Heel Tap Rock has been broken up, the tunnels at the Middle Reef (Flood Rock) during the year were driven an additional length of 7,312 linear feet, with the removal of 18,080 cubic yards of stone measured in place.

6. The amount that can be profitably expended during the year ending June 30, 1882, is the balance available, $307,903.16, which will be expended in completing the removal of the *débris* at Hallet's Point to the depth of 26 feet at mean low-water, removing Heel Tap and the reef at the North Brother, with some work on Frying Pan and Pot Rock, and in extending the tunnels and excavations in the Middle Reef (Flood Rock).

7. The estimated amount required for the entire and permanent completion of the work of improvement, in accordance with the approved and adopted project is $2,215,078.55.

The work is in the collection district of New York. The nearest port of entry is New York City.

The amount of revenue collected during year ending June 30, 1881, was $139,579,562.83. The amount of commerce and navigation benefited by the completion of this work would be about $4,000,000 daily.

ORIGINAL ESTIMATE.

Removing reefs at Hell Gate and Diamond and Coenties reefs	$5,139,120 00

AMOUNTS APPROPRIATED.

By act approved July 25, 1868		$85,000 00
By act approved April 10, 1869		178,200 00
By act approved July 11, 1870		250,000 00
By act approved March 3, 1871		250,000 00
By act approved June 10, 1872		225,000 00
By act approved March 3, 1873		225,000 00
By act approved June 23, 1874		225,000 00
By act approved March 3, 1875		250,000 00
By act approved August 14, 1876		250,000 00
By act approved June 18, 1878		350,000 00
By act approved March 3, 1879		250,000 00
By act approved June 14, 1880		200,000 00
By act approved March 3, 1881		200,000 00
Deduct amount reverted to United States Treasury	$3,158 55	
Deduct amount reverted to the Harlem River	11,000 00	
		14,158 55
		2,924,041 45
Amount expended		2,616,262 04

AMOUNT EXPENDED DURING YEAR ENDING JUNE 30, 1881.

Removing reef at Hallet's Point	$32,746 72
Excavations at Flood Rock	163,649 49
Crib between Great and Little Mill Rocks	4,069 88
Steam-drilling scow operating on Heel Tap Rock and North Brother	56,467 29
Rhinelander's Reef	48 09
	256,981 47

Money statement.

July 1, 1880, amount available	$296,638 81	
Amount received from sale of coal to Capt. James Mercur	123 75	
Amount appropriated by act approved March 3, 1881	200,000 00	
		$496,762 56
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	188,859 40	
July 1, 1881, outstanding liabilities	57,385 13	
		246,244 53
July 1, 1881, amount available		250,518 03
Amount (estimated) required for completion of existing project		2,215,078 55
Amount that can be profitably expended in fiscal year ending June 30, 1883.		300,000 00

A.

Detailed report of work at United States works, Flood Rock, New York, for the fiscal year ending June 30, 1881.

	Amount drilled.	Shifts.	Average depth drilled per shift.	Cost of drilling per linear foot.	Explosives used per cubic yard.	Average drilling per cubic yard.	Cubic yards removed.	Number of drills sharpened.	Loss of steel, abrasion and dressing.	Material bought.	Explosives bought.	Wages paid drillers and helpers.	Wages paid miners.	Wages paid blasters.	Wages paid smiths and helpers.
	Feet.	*No.*	*Feet.*	*Cents.*	*Lbs.*	*Feet.*	*No.*	*No.*	*Lbs.*						
Machine work: cost of drill, compressor, air pipes, and repairs	269, 182	8, 485, 375	31. 72	25. 1	2. 59	14. 88	18, 080	88, 272	4, 290	$15, 102 60	....	$37, 548 73	$63 92	....	$3, 665 06
Explosives and cost of laboratory, and repairs	....	....	....	....	....	....	....	....	....	73 65	$23, 680 39	....	....	$2, 128 89	....
Getting rock to shaft, mine cars, and railroad, and repairs	....	....	....	....	....	....	....	....	....	3, 921 19	....	110 45	287 18	....	610 59
Hoisting and engine, and repairs	....	....	....	....	....	....	....	....	....	1, 862 47	....	....	....	....	17 52
Dumping and scow chute, and repairs	....	....	....	....	....	....	....	....	....	249 22	....	....	....	....	83 83
Pumping and pump and repairs	....	....	....	....	....	....	....	....	....	4, 261 15	....	....	....	....	5 09
Tug Humphreys, and repairs	....	....	....	....	....	....	....	....	....	2, 777 26	....	....	....	....	5 33
Boilers, condenser, and repairs	....	....	....	....	....	....	....	....	....	1, 187 00	....	22 72	....	....	32 80
Timbering in mine	....	....	....	....	....	....	....	....	....	14 00	....	11 60	261 56	....	....
Crib (at Hallet's Point)	....	....	....	....	....	....	....	....	....	187 11	....	....	....	....	....
Crib and dike (between "Great and Little Mill Rocks")	....	....	....	....	....	....	....	....	....	1, 639 86	....	....	....	....	83 18
Ventilating mine (including cost of fan and engine)	....	....	....	....	....	....	....	....	....	1, 097 48	....	....	191 69	....	28 80
Water-boat, whale-boat, row-boat, and repairs	....	....	....	....	....	....	....	....	....	74 71	....	....	....	....	....
Repair shop (including cost of lathe), and repairs	....	....	....	....	....	....	....	....	....	1, 262 04	....	....	....	....	34 26
Superintendence, including cost of water, rent, &c	....	....	....	....	....	....	....	....	....	1, 128 09	....	....	....	....	238 99
Total	269, 182	8, 485, 375	31. 72	25. 1	2. 59	14. 88	18, 080	88, 272	4, 290	34, 837 83	23, 680 39	37, 693 50	804 35	2, 128 89	4, 805 45

Detailed report of work at United States works, Flood Rock, New York, for fiscal year ending June 30, 1881—Continued.

	Wages paid steam engineer and machinists.	Wages paid engineer of hoisting-engine.	Wages paid firemen and pumpmen.	Wages paid crew of tug Humphreys.	Wages paid watchman.	Wages paid receiver of materials.	Wages paid overseer and subovorseers.	Wages paid carpenters.	Wages paid assistant engineer, sounder, and boatmen.	Wages paid laborers.	Total cost.	Cost per cubic yard.
Machine work, cost of drill, compresser, air pipes, and repairs	$2,497 18		$2,447 15				$2,777 68	$236 66		$3,326 03	$67,665 01	$3 74.2
Explosives and cost of laboratory, and repairs								19 25		62 48	25,964 66	1 43.6
Getting rock to shaft, mine cars, and railroad, and repairs	7 50						1,007 43	1,663 59		19,553 87	27,161 80	1 50.2
Hoisting and engine, and repairs	30 00	$742 04	364 41					30 25		92 51	3,139 20	17.4
Dumping and scow chute, and repairs								245 11		980 16	1,558 32	8.6
Pumping and pump, and repairs	260 70		1,746 33					2 75		184 99	6,461 01	35.7
Tug Humphreys, and repairs	30 62			$3,862 21				175 71		49 25	6,900 38	38.2
Boilers, condenser, and repairs	682 14		159 47					47 49		1,335 18	3,466 80	19.2
Timbering in mine								5 50			292 66	1.6
Crib (at Hallet's Point)								224 47		84 05	495 63	2.7
Crib and dike (between "Great and Little Mill Rocks")	10 00							443 61		1,893 23	4.069 88	22.5
Ventilating mine, including cost of fan and engine.	14 87							389 80		362 05	2,084 09	11.5
Water-boat, whale-boat, row-boat, and repairs								382 77			457 48	2.5
Repair shop (including cost of lathe) and repairs	50 00							165 27			1,511 57	8.4
Superintendence, including cost of water, rent, &c	1,320 00				$1,185 65	$1,200 00	1,920 00	1,740 00	$2,459 33		11,192 06	62.0
Total	4,903 01	742 04	4,717 36	3,862 21	1,185 65	1,200 00	5,705 11	5,772 23	2,459 33	27,923 80	162,421 15	8 98.3

NOTE.—Total expenses less $4,069.88, cost of material and labor on crib and dike between Great and Little Mill Rocks, $158,351.27. Cost per cubic yard, $8.75.8.

Total cost of material	$34,837 83	Total cost of pay-roll	$103,902 93
Total cost of explosives	23,680 39	Total cost per cubic yard	8 98.3

Table showing progress on Flood Rock for fiscal year ending June 30, 1881.

Linear feet of galleries driven	7,312
Cubic yards of rock removed	18,080
Holes drilled	65,360
Number of blasts	61,595
Number of exploders used	61,595
Feet of fuse used	240,269
Pounds of powder used	48,866
Number of cars hoisted	32,102

B.

REPORT OF MR. ROY STONE, ASSISTANT ENGINEER.

UNITED STATES STEAM-DRILLING SCOW,
North Brother Reef, July 1, 1881.

SIR: Respecting the operations of the United States steam-drilling scow under my charge for the past fiscal year, I have the honor to report as follows:

After the conclusion of work upon Diamond Reef on June 30, 1880, the scow was towed to Gowanus Creek, and the time to August 10 was occupied in examining and scraping the bottom of scow, painting, and general repairs to hull and machinery and to the steamer Star.

Work upon Heel Tap Rocks, Hell Gate, began August 10, with surface blasting and removal, by divers, of the sharp peaks of the reef.

Drilling was commenced October 5, and was carried on with much less difficulty than was anticipated in the rapid tide-way of Hell Gate; the cost of drilling and all attendant work being less than on any previous work, and very much less than for the years previous to 1879.*

This is due mainly to the increase of boiler power in 1878, and the subsequent improvement in hauling gear, and in the arrangements for shifting engines, &c.

By the close of the season's work, December 21, this reef was reduced to 20 feet at mean low-water, and a large amount of broken rock left to be removed by grapple in the spring.

During the winter, while the scow lay in Gowanus Creek, a new bridge for drill carriage was built (creosoted), the position of dome-hoisting engines changed, almost an entire new deck laid and sheathed, beside the usual repairs to engines and machinery and putting new boiler in steamer Star. In April, 1881, a grapple dredge was employed for 6.9 days upon the Heel Tap Reef and removed 195.04 cubic yards of rock. On May 17, work was recommenced there with the drilling scow, and all the solid rock that could be found above the 26-foot plane drilled and blasted.

In one month 15 dome positions were found, 154 holes drilled, aggregating 1,394.3 feet in depth and blasted with 6,332 pounds No. 2 extra giant powder.

On June 20, the scow was removed to North Brother Reef, near Port Morris, and to this date 4 positions have been located, 65 holes drilled, aggregating 679.25 feet in depth, and blasted with 3,229 pounds No. 2 extra giant powder, and 66.08 cubic yards of rock have been removed by divers.

No serious damage by collision has occurred during the past year.

The vessel and machinery are in excellent order for service.

I have the honor to be, your obedient servant,

ROY STONE,
Assistant Engineer and Superintendent.

Col. JOHN NEWTON,
Corps of Engineers, U. S. A.

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*Average cost of linear foot of hole drilled, including placing of scow, lowering dome, expenses of drilling, cost of sharpening drills, expenditure of steel, hoisting up dome after drilling operations, and heaving off scow:

Diamond Reef, 1879-'80	$1 22
Heel Tap Rock, 1880	0 75
North Brother Reef, 1881	0 67

Tabular statement of operations from July 1, 1880, *to July* 1, 1881.

	Heel Tap Rock.	North Brother Reef.
Cubic yards of rock removed by dredge	195.04	
Cubic yards of rock removed by divers	832.58	66.08
Total number of holes drilled	268	65
Total number of feet drilled	2,549.7	679.25
Average depth of holes ....feet..	9.8	10.45
Size of drilling bit ....inches..	5.¾	5.¼
Average number of feet of holes drilled by each machine per shift of eight hours	12.92	12.72
Average cost of sharpening a drill	$1.65	$1.65
Average number of feet drilled to each sharpening	22.2	20.9
Expenditure of steel to each foot of hole drilled ....ounces..	0.8	0.7
Average cost of linear foot of hole drilled, including placing of scow, lowering dome, expenses of drilling, cost of sharpening drills, expenditure of steel, hoisting up dome after drilling operations, and heaving off scow	$0.81	$0.67
Number of drill-hole blasts	24	4
Amount of powder for drill-hole blasts ....pounds..	11,170	3,299
Average number of pounds of powder to each cubic yard of rock removed	10.87	
Average cost of powder to each cubic yard of rock removed	$4.80	
Total time of dredging ....days..	6.92	
Average cost of dredging and dumping one cubic yard of débris	$6.02	
Cost per cubic yard of rock removed	$22.18	
Average amount of powder per foot of hole drilled ....pounds..	4.4	4.9
Average cost of powder per foot of hole drilled	$1.98	$2.20
Number of surface blasts	40	
Amount of powder for surface blasts ....pounds..	4,664	

Tabulated statement of the commerce of the port of New York, for the years 1877, 1878, 1879, *and* 1880.

VESSELS ENTERED.

Year.	Coastwise.		American.		Foreign.		Total.	
	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.
1877	2,378	1,667,677	2,216	1,063,114	3,579	3,609,186	8,173	6,339,977
1878	2,105	1,648,892	2,213	1,132,170	4,260	4,412,856	8,578	7,193,918
1879	2,014	1,716,155	2,397	1,244,803	5,172	5,417,022	9,583	8,377,980
1880	2,255	1,928,585	2,366	1,309,800	5,775	6,301,482	10,396	9,539,867

VESSELS CLEARED.

Year.	Coastwise.		American.		Foreign.		Total.	
	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.
1877	3,491	2,025,401	1,817	902,174	3,456	3,550,421	8,764	6,477,996
1878	3,128	2,013,891	2,127	1,097,153	4,414	4,541,200	9,669	7,652,244
1879	3,135	2,068,817	1,966	1,107,313	4,991	5,297,534	10,092	8,473,664
1880	3,908	2,514,955	1,743	1,086,930	5,641	6,342,872	11,292	9,944,757

NUMBER AND TONNAGE OF STEAM AND SAILING VESSELS, BARGES, AND CANAL BOATS BELONGING TO THE PORT OF NEW YORK.

Year.	Sailing vessels.		Steam vessels.		Barges.		Canal boats.		Total.	
	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.
1877	2,614	587,015.80	803	347,522.01	505	117,464.34	339	25,436.99	4,261	1,067,439.14
1878	2,652	607,182.94	801	312,240.13	525	120,659.90	361	27,738.38	4,339	1,067,821.35
1879	2,623	579,804.11	796	289,477.74	536	129,045.30	404	32,314.13	4,359	1,025,641.28
1880	2,495	548,186.84	824	290,674.46	402	79,195.80	402	32,000.62	4,123	960,057.72

Tabulated statement of the commerce of the port of New York, &c.—Continued.

VALUE OF EXPORTS, IMPORTS, AND DUTIES COLLECTED AT PORT OF NEW YORK.

Year.	Exports.	Imports.	Duties.
1877	$326, 431, 140	$329, 088, 868	$91, 056, 961 97
1878	362, 522, 088	303, 186, 867	91, 431, 047 25
1879	371, 046, 609	424, 189, 123	96, 817, 543 06
1880	425, 193, 099	539, 326, 776	130, 431, 007 56

D 4.

IMPROVEMENT OF BUTTERMILK CHANNEL, NEW YORK.

The project and estimate for this work was submitted March 27, 1880, as an indorsement upon a communication of the Hon. Levi P. Morton to the Chief of Engineers. Estimated cost, $140,000.

The project recommended the removal of a sand-bar located about midway between Governor's Island and Atlantic-street ferry, Brooklyn. The effect of the shoal is to narrow and divide one of the most important channels of the harbor of New York.

Under the appropriation of June 14, 1880, of $60,000, a contract was made with Henry DuBois, October 20, 1880, for dredging the shoal within certain limits to a depth of 26 feet at mean low-water, at 35 cents per cubic yard, measured in place.

The original estimate was $140,000 for 570,000 cubic yards of material measured in place, which was at the rate of 24½ cents, nearly, per cubic yard.

The proposals made under public advertisement, however, have far exceeded this rate, and if continued in the future it will be necessary to increase the above estimate one-half and make it $210,000.

A further appropriation of $60,000 was made and approved March 3, 1881, with which it is proposed to enter into another contract on September 30 next (the date of expiration of the present contract), after public advertisement, and continue the work of the removal of the shoal.

1. The channel in its original condition was obstructed by a large shoal, with a minimum depth of 9½ feet at mean low-water, which lay in the direct track of navigation, too near the wharves of Brooklyn for the safe passage or manœuver of large vessels.

2. The originally adopted project for the improvement was the removal of a sufficient portion of this shoal to the depth of 26 feet at mean low-water, and thereby to increase the depth and width of the channel.

3. Nothing had been expended to the 30th June, 1880.

4. No alteration in the condition of the channel to that date.

5. The sum of $25,421.01 was expended during the fiscal year ending June 30, 1881, and the removal of about 80,000 cubic yards of material in place effected with an increase to the depth and width of the channel. No survey having been made at the close of the fiscal year, nothing more precise of the condition of the channel can now be stated.

6. During the fiscal year ending June 30, 1882, it is proposed to expend, with advantage to the improvement, the sum of $94,578.99, and to further increase the width and depth of the channel.

7. The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is $20,000, but, owing to the large and unexpected

advances in the cost of dredging since the first estimate was made, it is not unlikely that a further appropriation of $90,000 will be required.

The amount of commerce and navigation interested in this improvement is very great, though impossible to be furnished accurately, since it forms a part not easily separated from the rest of the commerce of the port of New York.

In a communication furnished by Messrs. J. P. & G. C. Robinson, June 29, 1880, and to be found in Report of Chief of Engineers for 1880, Part 1, pages 506 and 507, it is stated that at five piers south of South ferry, during the year 1879 there were 1,046 ships, barks, steamships, and brigs, besides canal boats and lighters. For the first quarter of 1880, there were reported 423 vessels.

Just in the neighborhood there are immense store-houses and grain-elevators.

Messrs. Robinson also state that within a month or so of the time when they wrote, two large vessels were aground on the shoal.

This work is in the collection district of New York. The nearest port of entry is New York City.

The amount of revenue collected during the last fiscal year was $139,579,562.83. The nearest light-house is Robbin's Reef. Amount of commerce benefited by the completion of this work, about $1,500,000 daily.

ORIGINAL ESTIMATE.

For dredging 570,000 cubic yards	$140,000 00

AMOUNTS APPROPRIATED.

By act approved June 14, 1880	$60,000 00
By act approved March 3, 1881	60,000 00
	120,000 00
Amount expended	25,421 01

Money statement.

July 1, 1880, amount available	$60,000 00	
Amount appropriated by act approved March 3, 1881	60,000 00	
		$120,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	25,421 01	
July 1, 1881, outstanding liabilities	5,600 00	
		31,021 01
July 1, 1881, amount available		88,978 99
Amount (estimated) required for completion of existing project		20,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		60,000 00

Abstract of bids for dredging Buttermilk Channel, New York Harbor; opened September 22, 1880.

Number.	Bidders.	Price per cubic yard measured in place.	Remarks.
1	Elijah Brainerd, jr	$0 85	$3 per ton for stone over 1 ton.
2	Henry E. DuBois	35	
3	Morris & Cumings Dredging Company	1 00	65 cents, in scows.
4	William Flannery	43	
5	George C. Fobes & Co		71 cents, in scows.
6	Atlantic Dredging Company	1 10	

Abstract of contract for dredging Buttermilk Channel, New York Harbor.

Contractor.	Residence.	Date of contract.	Subject of contract.	Remarks.
Henry E. DuBois	Brooklyn, N. Y.	Oct. 20, 1880.	Dredging shoal in Buttermilk Channel.	To be completed by September 30, 1881.

D 5.

IMPROVEMENT OF HARLEM RIVER, NEW YORK.

The survey of this work was directed by the act approved June 23, 1874; and on February 18, 1875, I reported a project and estimate for the improvement of the river from Randall's Island to the Hudson River.

The commissioners appointed by the supreme court have not yet completed the work of acquiring the right of way for the proposed cut or canal to connect the Harlem and Hudson rivers.

The work is in the collection district of New York. Nearest port of entry, New York. Nearest light-house, North Brother Island.

Amount of revenue collected during the year ending June 30, 1881, $139,579,562.83.

Amount of commerce to be benefited by this work, ———.

ORIGINAL ESTIMATE.

For 15-foot channel	$2,100,000 00

AMOUNTS APPROPRIATED.

By act approved June 18, 1878	$300,000 00
By act approved March 3, 1879	100,000 00
	400,000 00

Money statement.

July 1, 1880, amount available	$400,000 00
July 1, 1881, amount available	400,000 00
Amount (estimated) required for completion of existing project	1,700,000 00

D 6.

IMPROVEMENT OF FLUSHING BAY, NEW YORK.

The act approved June 18, 1878, directed the survey of Flushing Bay, the results of which, with a project of improvement and estimates of cost, were reported January 8, 1879.

The method of improvement recommended was by diking and dredging; by means of dikes a tidal reservoir was to be formed on the west or Newtown side, having its entrance at the head of the bay, by which means the tide of the bay would be received and emptied through a channel on the east side, and thus maintain a suitable depth after having once gained it by dredging.

The estimate for diking was $154,410.50, and for dredging, $19,089.50. Total, $173,500.

The appropriation of March 3, 1879, amounting to $20,000, was devoted to the construction of that portion of the line of diking lying nearest the head of the bay. Much opposition was manifested against the system of dikes at first on the part of residents on the Newtown side of the bay, undoubtedly because the channel proposed to be made would lie on the east side, at least in its deeper portions. Other minor reasons existed for the opposition, doubtless, but not of sufficient moment to mention here.

Considerable discussion was had as to the prospect of the diking system causing general shoaling of the bay, which result was not, however, considered at all likely by the engineer in charge.

The next appropriation, $15,000, approved June 14, 1880, was coupled with the following proviso:

> *Provided*, That in the judgment of the engineer officer in charge this expenditure can be made without serious detriment to the property interests on the Newtown side.

And it was decided to expend it in dredging along the line where it was supposed the future channel would form; that is, east of the dike. The reasons for dredging at this time were that an immediate necessity existed for a greater depth, and it was evident that many years must elapse before the dike could be completed and aid in forming the desired channel.

A contract was made with Mr. William Flannery to dredge a channel about 6,000 feet long leading from a depth of 6 feet at mean low-water on the East River side to a corresponding depth in the channel of the creek at Flushing, and 65 feet wide.

The dredging was reported as completed on June 24, 1881, but the final payment had not been made prior to the close of the fiscal year, from the necessity of having to await the report of the survey being made of the improved channel.

Another appropriation of $10,000 was made March 3, 1881, making the total of appropriations $45,000.

1. The original condition of the navigable channel was a depth at the shoalest part along the line leading to Flushing of 3.9 feet at mean low-water, and it was not therefore available for commerce.

2. The originally adopted project for the improvement was the formation of a tidal basin by means of dikes, which by its filling and emptying through one channel would keep up a depth of 6 feet at mean low-water, and even more after once having been dredged. No modification has been made in the project.

3. The amount expended up to the close of the fiscal year ending June 30, 1880, was $11,941.89.

4. During that fiscal year but a portion, about 3,000 feet, of diking was constructed, which would have no decided effect upon the channel.

5. The amount expended during the year ending June 30, 1881, was $14,234.89, upon diking and dredging, and a narrow channel having a depth of 6 feet at mean low-water now communicates with the creek at Flushing.

6. The amount that can be profitably expended in the fiscal year ending June 30, 1882, is the available balance, $18,823.22. After paying outstanding liabilities, the remainder to be devoted to widening the dredged channel and to diking.

7. The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is $128,500; but it is probable that the project may be completed for $75,000.

The amount of commerce and navigation to be benefited by the improvement is unknown; it is assumed that a development of trade by water would follow the improvement.

Flushing Bay is in the collection district of New York. Nearest port of entry, New York. Nearest light-house, North Brother Island.

Amount of revenue collected during the past fiscal year, $139,579,562.83. Amount of commerce to be benefited by this improvement, ———.

AMOUNTS APPROPRIATED.

By act approved March 3, 1879	$20,000 00
By act approved June 14, 1880	15,000 00
By act approved March 3, 1881	10,000 00
	45,000 00
Amount expended	26,176 78

ORIGINAL ESTIMATE.

4,400 linear feet of pile dike, at $10	$44,000 00
7,800 linear feet of pile dike, at $9	70,200 00
900 linear feet of pile dike, at $7.50	6,750 00
3,600 linear feet of single piling, at $3.70	13,320 00
Contingencies, engineering, &c	20,140 50
	154,410 50

ESTIMATED COST OF DIKES, WITH DREDGING.

4,400 linear feet of pile dike, at $10	$44,000 00
7,800 linear feet of pile dike, at $9	70,200 00
900 linear feet of pile dike, at $7.50	6,750 00
3,600 linear feet of single piling, at $3.70	13,320 00
83,000 cubic yards of dredging, at 20 cents	16,600 00
Contingencies, engineering, &c	22,630 00
	173,500 00

Money statement.

July 1, 1880, amount available	$15,639 45	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$25,639 45
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	6,816 23	
July 1, 1881, outstanding liabilities	4,531 48	
		11,347 71
July 1, 1881, amount available		14,291 74
Amount (estimated) required for completion of existing project		128,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		30,000 00

Abstract of bids for dredging in Flushing Bay, New York; opened December 7, 1880.

No.	Name of bidder.	Price per cubic yd. in scows.	Remarks.
1	Elijah Brainerd, jr	$0 34	
2	Atlantic Dredging Company	27	
3	Henry E. Du Bois	18	
4	Morris & Cumings Dredging Company	27	
5	William Flannery	17	

Abstract of contract for dredging in Flushing Bay, New York.

Contractor.	Residence.	Date of contract.	Subject of contract.	Remarks.
William Flannery	New York, N. Y.	Dec. 15, 1880	Dredging channel in Flushing Bay.	To be completed June 1, 1881.

D 7.

IMPROVEMENT OF GOWANUS BAY, NEW YORK.

The survey of Gowanus Bay was directed by the act approved June 14, 1880, and the results, with a project for improvement and estimates of cost, reported January 11, 1881. Estimated cost, $183,000. The project was to dredge the channel of Gowanus Canal from the bridge on Hamilton avenue to the pier at the foot of Twenty-seventh street, Brooklyn, and thence in a general southwesterly direction to prolong the excavation to the 18 foot contour line of the harbor.

There was no choice as to the direction and position of the proposed line of deepening, on account of being circumscribed by the pier lines proposed by a commission in 1875.

It was stated that the channel so dredged would not be permanent, and it was probable would not for many years receive any assistance in maintaining its depth from the contraction due to the construction of piers out to the legal limit.

A channel, partly natural and partly dredged, already existed from the Hamilton Avenue Bridge to the southwest corner of the Erie Basin, a portion of it lying within the pier line recommended in 1875.

By the act approved March 3, 1881, an appropriation of $40,000 was granted for "deepening and widening the channel in Gowanus Bay and the harbor of New York."

The terms in which the appropriation is couched seem to point to the improvement of the existing channel which lay partly within the projected pier lines, and was removed from the lines of the project submitted to Congress in the report of January 11, 1881. Messrs. Beard & Robinson submitted a paper to the engineer in charge by which they proposed to relinquish for all time (so long as the channel should exist) all right to build out piers from the wall of the Erie Basin which should interfere with such channel along the wall of the basin.

A petition from the Maritime Association of New York was at the same time presented to dredge, starting from the southwest angle of the Erie Basin, in a northerly direction close to the western wall of the basin to the deep water of the harbor.

All of these, including the terms of the appropriation itself, tended to take the channel away from the lines laid down in the map sent with the official report, and to deprive the wharves of Bush & Denslow and of the Phœnix Chemical Works on the south shore of Gowanus Bay of the advantages of the channel.

Under these circumstances it was recommended to the Engineer Department by letter of June 7, 1881, from this office, to dredge the existing channel from Hamilton avenue to the southwest corner of Erie Basin, under the stipulation aforesaid of Messrs. Beard & Robinson not to interfere with the same, and thence to divide it into two branches, one to the north in compliance with the petition of the Maritime Association, and the other to the south to accommodate the shipping at wharves of Bush & Denslow, and of the Phœnix Chemical Works.

It was also stated in this communication that the north and south branches starting from the southwest angle of Erie Basin lay without the proposed pier lines and could be undertaken without further delay or waiting for searches of title, or legal matters pertaining to the agreement of Messrs. Beard & Robinson.

The reply to the communication was not received prior to the end of the fiscal year, and no action can be reported either as to the adopted plan or to future operations under the appropriation of $40,000, made and approved March 3, 1881.

ESTIMATED COST OF THE LAST PROJECT.

583,530 cubic yards of dredging, at 30 cents	$175,059 00
Engineering and other contingencies	17,505 90
Total	192,564 90

Messrs. Downing & Lawrence, November 29, 1880, mention the amount of tonnage of vessels using the channel as 370,176 tons, comprising ocean steamers, ships, barks, brigs, also 27,729 tons of schooners, during the period from January to December, 1880.

The business for one year ending December, 1880, along Gowanus Canal is stated by Mr. J. T. Robinson to have been $5,274,500.

Reference is made to House Ex. Doc. No. 48, Forty-sixth Congress, third session, pages 3 and 4.

The work is in the collection district of New York. The nearest port of entry, New York City. The nearest light-house, Robbins' Reef. The amount of revenue collected at the port of New York during the fiscal year ending June 30, 1881, $139,579,562.83. The amount of commerce and navigation to be benefited is about $5,000,000.

ORIGINAL ESTIMATE.

530,000 cubic yards of dredging, at 30 cents	$159,000 00
Engineering and contingencies	23,850 00
	182,850 00

AMOUNT APPROPRIATED.

By act approved March 3, 1881	$40,000 00

Money statement.

Amount appropriated by act approved March 3, 1881	$40,000 00
July 1, 1881, amount available	40,000 00
Amount (estimated) required for completion of existing project	142,850 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	60,000 00

SURVEY OF GOWANUS BAY, NEW YORK.

UNITED STATES ENGINEER OFFICE,
New York, January 11, 1881.

GENERAL: I have respectfully to forward a report on the survey of Gowanus Bay, as provided in the river and harbor act approved June 14, 1880.

The commerce to be benefited and the depth of channel needed for the wants of commerce are explained in Exhibits A, B, and C, sent herewith.

The chart sent herewith exhibits in red lines the exterior pier and bulkhead lines as defined by authority of the State of New York, which fix within a narrow margin the position of the channel to be dredged or improved.

The estimate for a depth of 18 feet at mean low-water is $183,000. The channel so dredged will not be permanent, and it is feared will not for many years receive any assistance in retaining its depth from the contraction caused by the construction of the piers to the legal limit.

Gowanus Bay is in the collection district of New York.

New York is the nearest port of entry. The nearest light-house is Robbins' Reef light, and the nearest fort is Fort Columbus.

The amount of revenue collected at the port of New York during the past fiscal year is $131,812,349.89.

The amount of commerce and navigation to be benefited by the proposed improvement, as estimated by parties engaged in business in the locality, is about $5,000,000.

The total amount of tonnage for the past fiscal year, as furnished by the same parties, is 398,905 tons.

The survey was made during the past season by the party under the charge of Mr. Matthew Cox, assistant engineer, under instructions from this office.

Respectfully submitted.

JOHN NEWTON,
Colonel of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. R. H. TALCOTT, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
New York, January 10, 1881.

GENERAL: I have the honor to submit the following report on the survey of Gowanus Bay, New York, together with such information in regard to the commerce and navigation of the same as I have been able to obtain.

The accompanying chart shows the results of the late survey, and the works of improvement completed and in progress, and also the proposed dredging. An estimate of the probable cost of the latter is appended hereto.

Gowanus Bay is in the collection district of New York.

New York City is the nearest port of entry. The nearest light-house is Robbins' Reef light, and the nearest fort is Fort Columbus, on Governor's Island.

The amount of revenue collected at the port of New York during the past fiscal year is $131,812,349.89.

The amount of commerce and navigation to be benefited by the proposed improvement, as estimated by the parties engaged in business in this locality, is about $5,000,000.

The total amount of tonnage for the past fiscal year, as furnished by the same parties, is 398,905 tons.

Extensive improvements are in progress in Gowanus Bay, especially on the northerly shore, where a large basin is in progress of construction and several slips are proposed, which, when finished, will give great facilities for the loading and discharging of vessels. These improvements are shown on the chart in full lines where the dock-front is completed, and in broken lines where only proposed.

In 1875 a commission, appointed by the legislature of the State, established pier and bulkhead lines in Gowanus Bay. These lines do not correspond with the exterior lines of the improvements on the northerly side of the bay, along which the present channel runs, except in the upper part, but they limit the space in which the new channel must be dredged. These lines are shown in red on the accompanying chart.

The improvement proposed is to dredge a channel from the 18-foot contour outside the bay to the draw-bridge for Hamilton avenue. This channel is estimated at 18 feet deep at mean low-water and 200 feet wide, except the last few hundred feet near the draw-bridge, where it will gradually narrow down to 100 feet.

The survey was made during the latter part of October and 1st of November by the party under the charge of Mr. Matthew Cox, assistant engineer, under instructions from this office.

The plane of mean low-water to which all the soundings were reduced was obtained by a line of levels from the United States coast and Geodetic Survey bench mark on the Atlantic stores to the tide-staff in Gowanus Bay.

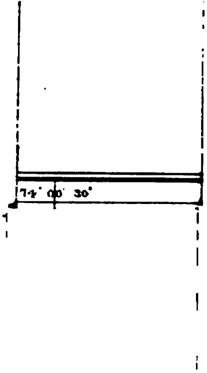
ESTIMATE.

530,000 cubic yards of dredging, at 30 cents	$159,000 00
Engineering and contingencies	23,850 00
	182,850 00

All of which is respectfully submitted by your obedient servant,

R. H. TALCOTT.

Col. JOHN NEWTON,
Corps of Engineers, U. S. A.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A.

LETTER OF MESSRS. DOWNING & LAWRENCE.

BROOKLYN, *November* 29, 1880.

DEAR SIR: In reply to yours of 19th instant, we have to say that Gowanus Bay Channel should have from 15 to 18 feet water at ordinary low-water.

During the year 1880, from January to November 29, the following mentioned vessels have been up this channel, and very much annoyance has been occasioned by the shallowness of water:

	Tons.
5 ocean steamers, aggregate tonnage	4,194
50 ships, aggregate tonnage	59,861
498 barks, aggregate tonnage	287,127
65 brigs, aggregate tonnage	19,994
Total tonnage deep-water vessels	370,176
In addition to above, 198 schooners	27,729
Making grand total of registered tonnage	398,905

besides an immense traffic in oil, lumber, bricks, iron ore, &c. The above figures can be verified by reference to custom-house records. When this channel is deepened, very many more large vessels will make use of it. We think that during the year 1879 there were quite as many vessels in this district as in 1880. If we can be of any further service to you in this or any other cause, please command us.

Yours, truly,

DOWNING & LAWRENCE.

General JOHN NEWTON, *U. S. A.*

B.

Names of parties doing business on and adjacent to the Gowanus Canal, in the city of Brooklyn, N. Y., and statement of amounts in value, quantities, and style of business, for one year ending December 1, 1880.

Names.	Kind of merchandise.	Quantity.	Value.
Kenyon & Newton	Lumber and timber	5,000,000 feet	$150,000
Watson & Pattinger	do	6,000,000 feet	160,000
Kelseys & Loughlin	Coal and wood	50,000 tons	250,000
H. W. Jones & Co	do	About 8,000 tons	40,000
Hobby & Leeds	Lumber, bricks, &c	73,000 tons	180,000
J. Pieper's Sons	Wood		31,500
S. W. Browne & Co.	Hay and grain	27,000 tons	600,000
Nelson & Holden	Coal and wood		265,000
P. G. Hughes	Masons' materials		150,000
John Fink	Coal and wood	6,000 tons	40,000
J. T. Story	Coal	30,000 tons	150,000
G. Ross & Sons	Lumber and timber	4,000,000 feet	125,000
Halstead Brothers	do	1,000,000 feet, 6 mos.	50,000
A. W. Adams	Masons' materials		75,000
J. S. Loomis	Lumber, moldings, &c	4,500,000 feet	125,000
William Bradley	Freestone	3,000 tons	48,000
Edward C. Pease	Lumber and mill	1,000,000 feet	75,000
J. Morton & Sons	Masons' materials	400 vessels of 160 tons	250,000
Brooklyn Improvement Company	Lumber and material	10,000,000 feet	500,000
South Brooklyn Saw-Mill Company	Timber	6,250,000 feet	250,000
J. T. E. Litchfield & Co.	Lumber and timber	4,000,000 feet	100,000
Weber & Quinn	Coal and wood	45,000 tons	125,000
Cary & Evans	Hay and grain	45,000 tons	90,000
P. H. Quinn	Coal and wood	10,000 tons	50,000
J. T. Schmadecker	do	40,000 tons	160,000
Murtha & Boyle	do	50,000 tons	250,000
Knight & Lidford	do	18,000 tons	90,000
H. S. Christian	Masons' materials		175,000
Rankin & Ross	Freestone	2,500 tons	45,000
George F. Gregory	Petroleum oil	100,000 barrels	600,000
H. J. Baker & Brother	Chemicals and fertilizers		75,000
			5,274,500

Vessels recorded in custom-house arriving in Gowanus Bay Channel for eleven months, January 1 to December 1, 1880.

5 steamers, aggregate	4,194 tons,	average	839 tons.
50 ships, aggregate	59,861 tons,	average	1,197 tons.
498 barks, aggregate	287,127 tons,	average	576 tons.
65 brigs, aggregate	19,994 tons,	average	307 tons.
198 schooners, aggregate	27,729 tons,	average	140 tons.
	398,905		

(Received from Mr. Jeremiah P. Robinson.)

C.

LETTER OF THE PRESIDENT OF BUSH AND DENSLOW MANUFACTURING COMPANY.

NEW YORK, *November* 20, 1880.

DEAR SIR: Your esteemed favor of the 19th instant at hand and contents noted. In answer we would state that the depth of water required by the parties up the creek, which we understand to be 21 feet at low-tide, would be sufficient for most of the vessels coming to our docks and to those of our neighbors.

The largest vessels afloat are employed in carrying petroleum, but we could scarcely ask for more water than is required in the general shipping business. We will gladly hold ourselves ready to give you any additional information or assistance within our reach.

Yours, very respectfully,
BUSH AND DENSLOW MANUFACTURING COMPANY,
By R. T. BUSH,
President.

Mr. R. H. TALCOTT,
Assistant Engineer.

D 8.

IMPROVEMENT OF NEWTOWN CREEK, NEW YORK.

The survey was directed by the act approved March 3, 1879, and the results, with a project of improvement and estimates of cost, reported January 31, 1880. Estimated cost, $36,250.

The project contemplated dredging and deepening the channel from the mouth to the bridge at Vernon avenue.

Under the appropriation of $10,000, approved June 14, 1880, a contract was made, after public advertisement, November 6, 1880, for dredging a channel 60 feet wide and 18 feet deep at mean low-water, from the mouth of the creek to Vernon avenue.

The contract was completed in June, 1881; the width prescribed for the channel being as great as could be given, with the funds available. Owing to the increased cost of dredging, it will be safer to advance the original estimate to $46,000.

It was found impossible to extend the dredging to the bridge, owing to the continual use of the draw, and as much of the bottom was soft, and to some extent flowing, the full depths attained could not be kept under a width of the cut restricted to 60 feet.

1. The original condition of the channel gave a depth of 12½ to 18 feet at mean low-water, which was insufficient for the large class of vessels frequenting the creek. The width was 240 feet.

2. The original adopted project for the improvement was to dredge a channel about 200 feet wide and from 18 to 21 feet in depth, and no change has been made

3. Nothing has been expended up to the close of the fiscal year ending June 30, 1880.

4. No change in the condition of the creek to same date.

5. The amount expended during the year ending June 30, 1881, was $7,566.48, and the depth of the channel along the cut made is generally over 17 feet, with a minimum depth of 15½ feet.

6. The balance on hand, $2,433.52, will probably be expended during the year ending June 30, 1882, in removing bowlders and improving the cut already made.

7. The estimated amount for the entire completion of the work of improvement, in accordance with the approved and adopted project, would be $36,000 by the revised, and $26,250 by the original, estimate.

The commerce of the creek is very large, and the amount of active business so great as to make it difficult to work upon the improvement.

Mr. Francis Pidgeon, February 7, 1880, states:

> There are at this time 18 large square-rigged vessels lying in the creek, and in sight from the bridge. There is a trade of $10,000,000 annually done in refined oil, and I am told by one of the firm of the Devoe Manufacturing Company that their firm loaded 18 vessels with refined oil for foreign ports, in the month of January last. * * *
>
> Many large firms are located on the creek. There are the Sone and Fleming Company, Empire and Brooklyn Refineries, and many other large concerns which would be tedious to mention.
>
> There are from 150 to 200 vessels, consisting of ships, lighters, tugs, &c., passing through the draw daily. * * *

There is no question of the extreme activity to be daily witnessed on the creek.

The work is in the collection district of New York. Nearest light-house is on Blackwell's Island.

Amount of revenue collected during the past fiscal year $139,579,562.83. Amount of commerce to be benefited by the completion of this work, ———.

ORIGINAL ESTIMATE.

Dredging 145,000 cubic yards	$36, 250 00

AMOUNT APPROPRIATED.

By act approved June 14, 1880	$10, 000 00
Amount expended	7, 566 48

Money statement.

July 1, 1880, amount available	$10, 000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	7, 566 48
July 1, 1881, amount available	2, 433 52
Amount (estimated) required for completion of existing project	26, 250 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	36, 000 00

Abstract of bids for dredging in Newtown Creek, East River, New York; opened October 29, 1880.

No.	Name of bidder.	Price per cubic yard in place.	Remarks.
1	William Flannery	$0 43	

Abstract of contract for dredging in Newtown Creek, East River, New York.

Contractor.	Residence.	Date of contract.	Subject of contract.	Remarks.
William Flannery	New York, N.Y.	Nov. 6, 1880.	Dredging channel in Newtown Creek.	To be completed April 1, 1881.

D 9.

IMPROVEMENT OF EAST CHESTER CREEK, NEW YORK.

The survey of this creek was directed by the act approved March 3, 1871, and on January 19, 1872, I reported projects and estimates for the improvement upon different scales of magnitude.

On April 3, 1872, a partial project for an improvement from Town Dock to a point 3,000 feet above Lockwoods was submitted at an estimate of $136,000, which was intended to secure a depth of 9 or 10 feet at mean high-water, between the points named.

Under this project a cut has been excavated through marsh meadow and rock, and the channel thereby straightened between Town Dock and Lockwoods. Under the old bridge, on the Boston road (which has been replaced with a new structure by the local authorities), the waterway was deepened and widened.

The remainder of the project, viz, the construction of a tidal basin above Lockwoods, estimated to cost $83,000, has not been undertaken for want of funds. In addition to the project a channel has been excavated west of Goose Island to afford a depth of 9 or 10 feet at mean low-water, and a large quantity of bowlders and gravel just below Pelham Bridge, endangering navigation, has been removed.

1. The original condition of navigation was, between Town Dock and Lockwoods, a draught of less than 7 feet at high-water through an intricate, crooked, and narrow channel, a draught in the channel south of Goose Island, rather more than 7 feet at high-water, and a dangerous reef of bowlders, &c., in close proximity to the course of vessels in passing the draw at Pelham Bridge.

2. The originally adopted project was for the making of a channel of 9 or 10 feet of draught at high-water from Town Dock to a point 3,000 feet above Lockwoods, which included the construction, not yet undertaken, of a tidal basin above Lockwoods. To this have been since added the dredging of the channel west of Goose Island, and the removal of the reef of bowlders, gravel, &c., just below Pelham Bridge.

3. The amount expended to the close of the fiscal year ending June 30, 1880, was $46,627.86.

4. At that date from the absence of complaint it was inferred—no surveys, however, having been made to test the fact—that the channels retained the depth of 9 or 10 feet at high-water.

5. During the fiscal year ending June 30, 1881, no expenditures have been made.

6. As to the amount which can be profitably expended during the year ending June 30, 1882, it is not proposed to extend the improvement already completed.

It may be necessary to rectify defects which a future examination may discover in portions of the channels already operated upon. Furthermore, until it is proved that a depth of 9 or 10 feet at high-water, deemed sufficient for the requirements of commerce in this locality, cannot be maintained under the scale of improvement already completed, it will be unnecessary to inaugurate new works. The amount of funds available, $7,372.14, will be quite sufficient for the present wants of the case.

7. The amount necessary to be appropriated for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project, if entirely carried through as designed, is $82,500.

This work is in the collection district of New York. Nearest port of entry, New York. Nearest light-house, Stepping Stones.

Amount of revenue collected during the year ending June 30, 1881, $139,579,562.83.
Amount of commerce benefited by the completion of this work, $2,238,203.

ORIGINAL ESTIMATE.

Basin, purchase of site, 18 acres, at $150	$2,700 00
Excavation to level of mean low-water, 200,000 cubic yards, at 40 cents	80,000 00
Excavation of cut 60,000 cubic yards, at 40 cents	24,000 00
Diking and revetting bank of cut	12,000 00
Engineering and contingencies	17,800 00
	136,500 00

AMOUNTS APPROPRIATED.

By act approved March 3, 1873	$25,000 00
By act approved March 3, 1875	12,000 00
By act approved June 18, 1878	10,000 00
By act approved March, 3, 1879	3,500 00
By act approved June 14, 1880	3,500 00
Total	54,000 00
Amount expended	46,627 86

Money statement.

July 1, 1880, amount available	$7,372 14
July 1, 1881, amount available	7,372 14
Amount (estimated) required for completion of existing project	82,500 00

D 10.

IMPROVEMENT OF ECHO HARBOR, NEW ROCHELLE, NEW YORK.

The survey was directed by the act approved March 3, 1875, and the results with a project of improvement and estimates of cost reported March 3, 1875.

Echo Harbor is a well-sheltered expanse of water, being land-locked on all sides, except the southeast, where it opens into Long Island Sound.

The improvement designated was the removal of two reefs, "Start Rock" and "Sheepshead Rock." The amount of the estimate was $38,955.38, and it was reported that such improvement would be for the benefit of local commerce.

Under the first appropriation of $10,000, June 18, 1878, "Start Rock" was removed in 1879 to a depth of 7 feet at mean low-water. The appropriations of $3,000 made March 3, 1879, and of $3,000 June 14, 1880, did not suffice with the balance left from the first appropriation to commence the removal of Sheepshead Rock, nor was it until the appropriation of $3,000 March 3, 1881, had become available that this work could be undertaken.

Proposals have been since accepted for the removal of a portion of this reef (amounting to 506 cubic yards) to the depth of 9 feet at mean low-water.

1. The original condition of navigation showed rocky obstructions, "Start Rock" and "Sheepshead Rock," the former exposed in part at low-water and the latter with a least depth over it at mean low-water of 1 foot.

2. The originally adopted project was the removal of these rocks, the former to 6 feet at mean low-water, and the latter to 9 feet. A change of project was made by increasing the depth of removal of Start Rock to 7 feet at mean low-water.

3. The amount expended to June 30, 1880, was $10,288.54.

4. The condition of the improvement was the removal of Start Rock to the depth of 7 feet at mean low-water.

5. The amount expended during the fiscal year ending June 30, 1881, was $98.93, and without change in the navigable condition of the harbor.

6. The amount that can be profitably expended during the year ending June 30, 1882, will be the available balance, $8,612.53, for the removal of a portion of Sheepshead Rock to the depth of 9 feet at mean low-water.

7. The estimated amount for the entire and permanent completion of the work of improvement, in accordance with the approved and adopted project, is $19,955.38.

From information furnished in December, 1875, it was stated that the tonnage of the port for the previous three years was 50,000 tons per annum, and the value of the commerce $1,500,000 per annum.

This work is in the collection district of New York. Nearest port of entry, New York. Nearest light-house, Execution Rock.

Amount of revenue collected for the year ending June 30, 1881, $139,579,562.83.
Amount of commerce to be benefited by the completion of this work, $1,500,000.

ORIGINAL ESTIMATE.

Removing Sheepshead Rock	$21,201 75
Removing Start Rock	12,672 50
Contingencies	5,081 13
Total	38,955 38

AMOUNTS APPROPRIATED.

By act approved June 18, 1878	$10,000 00
By act approved March 3, 1879	3,000 00
By act approved June 14, 1880	3,000 00
By act approved March 3, 1881	3,000 00
Total	19,000 00
Amount expended	10,387 37

Money statement.

July 1, 1880, amount available	$5,711 46	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$8,711 46
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		98 83
July 1, 1881, amount available		8,612 63
Amount (estimated) required for completion of existing project		19,955 38
Amount that can be profitably expended in fiscal year ending June 30, 1883		13,000 00

D II.

IMPROVEMENT OF HARBOR AT NEW ROCHELLE, NEW YORK.

The act approved June 14, 1880, directed the survey of this harbor, and the results, with a project of improvement and estimates of cost, were reported January 28, 1881. The estimated cost was $40,825.

The act approved March 3, 1881, appropriated $20,000 for this work, and it is proposed to devote this sum to the formation of a channel around Glen Island of the depth of 6 feet at mean low-water; and to remove a rock in the outlet of that channel to a depth of 8 feet at mean low-water.

The essential features of this improvement are the excavation of the channel above named, completed to the depth of 8 feet at mean low-water, the removal of the rock at its outlet, the removal of Corning's Rock, and the removal of the rock marked C upon the chart transmitted January 28, 1881.

Other rocks will require simple marking, by beacon or otherwise, so that their position may be known.

1. The original condition of the channel was narrow and interspersed with sunken reef of rocks, which made it dangerous for navigation, and in the channel proposed to be excavated by dredging, the depth varied from 0 to 8 feet at mean low-water.

2. The originally adopted project was to remove the rocky obstruction and dredge an inner channel between Hunter's and Flat islands; the estimated cost was $40,825, and this project has not been modified.

3. There were no expenditures up to June 30, 1880.

4. The condition remained unaltered at that time.

5. The expenditures during the year ending June 30, 1881, $231.15, were for incidental purposes only, no work being done.

6. The amount that can be profitably expended during the year ending June 30, 1882, will be the balance of $19,768.85, devoted to the formation of a channel around Glen Island by dredging and removing rock of the depth of 6 feet at mean low-water, and of the width of 100 feet.

7. The estimated sum required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is $20,825.

The interests to be benefited by the improvement were stated in the report of January 28, 1881, containing the projects and estimates in these words:

> The improvement indicated by the present survey refers to that part of New Rochelle Harbor, contiguous to Glen and Flat islands, upon which buildings adapted to the purposes of a summer resort have been erected. A number of steamers convey excursionists during the warm season to these islands, and it is understood that the object of the examinations just made of the channels is to prepare safe and convenient lines of approach and departure from the islands selected for the purposes named. Commerce and trade with New Rochelle have apparently little to do with the proposed improvement.
>
> The amount of tonnage of the steamers and barges conveying the excursionists to the islands named is not known. The trips, however, are frequent and the number of passengers large.

The improvements stated will conduce to the protection of life of excursionists in search of fresh air and health, although no commerce may be directly benefited thereby.

New Rochelle Harbor is in the collection district of New York. Nearest port of entry, New York city. Nearest light-house, Execution Rock, Long Island Sound.

Amount of revenue collected during fiscal year ending June 30, 1881, $139,579,562.83.

ORIGINAL ESTIMATE.

Removal of the "Corning Rock":		
150 cubic yards rock excavation, at $40	$6,000 00	
Engineering and contingencies	900 00	
		$6,900 00
Dredging inner channel and removing rock:		
45,000 cubic yards dredging, at 30 cents	13,500 00	
300 cubic yards rock excavation, at $20	6,000 00	
Engineering and contingencies	2,925 00	
		22,425 00
Removal of rock "C" east of Flat Island dock:		
400 cubic yards rock excavation, at $25	10,000 00	
Engineering and contingencies	1,500 00	
		11,500 00
		40,825 00

AMOUNT APPROPRIATED.

By act approved March 3, 1881	$20,000 00
Amount expended	231 15

Money statement.

Amount appropriated by act approved March 3, 1881	$20,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	231 15
July 1, 1881, amount available	19,768 85
Amount (estimated) required for completion of existing project	$20,825 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	19,000 00

SURVEY OF NEW ROCHELLE HARBOR, WESTCHESTER COUNTY, NEW YORK, FROM CITY ISLAND TO THE TOWN OF NEW ROCHELLE.

UNITED STATES ENGINEER OFFICE,
New York, January 28, 1881.

GENERAL: I have respectfully to report upon the survey of "New Rochelle Harbor, Westchester County, New York, from City Island to the town of New Rochelle," as directed in the river and harbor act approved June 14, 1880.

New Rochelle Harbor is in the collection district of New York.

New York City is the nearest port of entry. The nearest light-house is on Execution Rock in Long Island Sound, and the nearest fort is Fort Schuyler, distant about 6 miles in a southerly direction.

The amount of revenue collected at New York City during the past fiscal year is $131,812,349.89.

The very limited trade by water with New Rochelle is carried to Echo Harbor, which embraces the water-front now in use. Echo Harbor has already been the subject of improvement through appropriations granted by Congress.

One reef of rock has been removed, but further funds are necessary to complete the project.

The improvement indicated by the present survey refers to that part of New Rochelle Harbor, contiguous to Glen and Flat Islands, upon which buildings adapted to the purposes of a summer resort have been erected. A number of steamers convey excursionists during the warm season to these islands, and it is understood that the object of the examinations just made of the channels is to prepare safe and convenient lines of approach and departure from the islands selected for the purposes named. Commerce and trade with New Rochelle have apparently little to do with the proposed improvement.

The amount of tonnage of the steamers and barges conveying the excursionists to the islands named is not known. The trips, however, are frequent and the number of passengers large.

The survey was made by the party under the charge of Mr. Charles G. Weir, assistant engineer, under the supervision of Mr. R. H. Talcott, assistant engineer, whose report, together with the chart of the locality, is forwarded herewith.

The very full report of Mr. Talcott, in connection with the chart, gives an adequate idea of the difficulties and risks to navigation at the present time, and of the improvements to be made for its amelioration.

If it should be decided to improve the approaches to Glen and Flat Islands, in the harbor of New Rochelle, and to excavate a channel around Glen Island, the estimated cost would be:

Approaches to Glen Island:		
Removal of Corning Rock, 150 cubic yards, at $40	$6,000 00	
Engineering and contingencies, 15 per cent	900 00	
		$6,900 00
Excavating interior channel around Glen Island:		
Dredging 45,000 cubic yards, at 30 cents	13,500 00	
Rock excavation, 300 cubic yards, at $20	6,000 00	
Engineering and contingencies, 15 per cent	2,925 00	
		22,425 00
Approaches to Flat Island:		
Removal of Rock "C," 400 cubic yards, at $25	10,000 00	
Engineering and contingencies, 15 per cent	1,500 00	
		11,500 00
		40,825 00

The dredging of the interior channel around Glen Island will not, it is supposed, secure a permanent improvement, nor do the features of the locality indicate any mode of insuring such permanence.

Respectfully submitted.

JOHN NEWTON,
Colonel of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. R. H. TALCOTT, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
New York, January 27, 1881.

GENERAL: I have the honor to submit the following report on the survey of New Rochelle Harbor, Westchester County, New York, from City Island to the town of New Rochelle, which has been made during the past season.

The accompanying chart shows the present condition of the channels and the works proposed for their improvement.

An estimate of the probable cost of these works is appended hereto.

New Rochelle Harbor is in the collection district of New York.

New York City is the nearest port of entry.

The nearest light-house is Execution Rock light, in Long Island Sound, and the nearest fort is Fort Schuyler, on Throgg's Neck, about 6 miles distant in a southerly direction.

The amount of revenue collected at New York City during the past fiscal year is $131,812,349.89.

The amount of commerce and navigation to be benefited by the proposed improvement is prospective.

The amount of tonnage for the past year is not known.

New Rochelle Harbor is in the southerly part of the town of New Rochelle. New Rochelle being mostly a place of summer residence, and having communication with New York City by two railroads, there is only a small amount of freight transported by water, and that is carried to Echo Harbor, which is only a little farther north, and just as convenient to the town.

The navigation of Echo Harbor has already been improved by the removal of one rock, which was a great obstruction, and a portion of the funds necessary for the removal of the second rock are already appropriated.

It is urged, however, by those interested in having New Rochelle Harbor and the channel leading to it improved, that whereas at Echo Harbor there is no water alongside of the docks for some time before mean low-water, except at the entrance to the inner harbor, at New Rochelle Harbor there is always deep water, and that, with an improvement in the channel leading to it, vessels could come and go at all times of the tide.

In the progress of the survey care has been taken to develop the bottom as thoroughly as possible. Inquiries were made as to the position of the known reefs of rock, and these have been accurately located, and where they obstructed navigation have been sufficiently developed for a calculation of the probable cost of their removal. It would be impossible to be sure that all the reefs had been found without sweeping the whole area surveyed, and for this operation neither time nor funds were available.

There are no obstructions to vessels of moderate draught between City and Hart's Islands which need removal; for though, at its southerly entrance, the channel is narrow, and there is a large flat the rest of the way between the islands, there is now nearly 15 feet of water on this flat at mean low-water, and no known reefs of rocks until Rat Island is encountered. This island is a rocky reef and partially immersed at all tides. It is on the west side of the channel and easily avoided. On the Hart's Island side there is a reef of rocks about midway between the two docks, but it is well out of the channel, and only dangerous to vessels intending to land at Hart's Island.

From City Island, for some distance north, there is a good deep channel, clear of obstructions, with the exceptions of a sunken reef of rocks about one-fourth of a mile northeast of High Island, marked "A," which rises suddenly out of deep water to within 12 feet of the plane of mean low-water, and a reef extending northwesterly from the upper end of Hart's Island, which has about 14 feet of water over it at mean low-water. These reefs are not dangerous for vessels of the draught now used, or likely to be used, for traffic in this locality.

About a half of a mile south of David's Island there is quite a large reef of rocks called Machaux Rocks, which are partially uncovered at mean low-water, but they are well to the east of the channel as now used, and no obstruction to its navigation.

There is a small reef, marked "B," with only 14 feet of water on it, about 500 feet west of Machaux Rocks, which is directly in the channel, but vessels with sufficient draught to touch it would not be able to pass the shoal water just north of it, so it can hardly be considered an obstruction.

Before reaching David's Island the water shoals rapidly, and a large mud flat extends all the way across to Hunter's Island, with only about 9 feet over it at mean low-water. The bottom of this shoal is soft mud with few exceptions, and there are oyster beds until near the Hunter's Island shore, where several rocks appear and render navigation dangerous. They are not near enough to the channel to require removal.

Between David's Island and the Flat and Glen Islands there are two channels, both of them with deep water.

These channels are separated by a chain of rocky islands and sunken reefs of rock. The westerly channel is quite straight, and, though narrow, is safe when care is taken to avoid the rocks near its southerly end, which are now buoyed.

The easterly channel, which is the deepest, is now rather dangerous and intricate, for, in addition to the reefs which show at low-water, there is a sunken reef a little northeast of Goose Island, which has only about 8 feet over it at mean low-water, and is almost directly in the channel. The propeller Erastus Corning struck on this reef last summer when loaded with excursionists, and sank after being run ashore.

This reef seems to have been unknown until this accident, which has given it the name of the "Corning Rock."

Its removal would be a great benefit to navigation. From this point into the harbor there is a deep channel, and though there are several reefs of rock, they do not obstruct navigation, as they are well known and are buoyed. The great trouble experienced now is that, after getting into the harbor, there is very little room for a long vessel or steamboat to turn round in, and much time is lost in that operation. To relieve this it has been suggested by those interested in the improvement, that a channel could be dredged round the islands and enter the main channel north of Hunter's Island. For some distance from the Neptune House, where the present landing is located, there is already a good channel back of the islands, which would be safe for vessels if buoys were placed on two reefs of rock, marked "D" and "E," which are close to the edge of the channel.

Between Hunter's and the Flat islands, in the deepest part, there are now only a few inches of water at mean low-water for some distance. This shoal seems to be soft mud, and the borings which have been made have not developed any rock which would interfere with the dredging of a channel of moderate depth through it. Near the mouth of the channel, where the water is already quite deep, a ledge of rock, marked "F," with about 2 feet on it in the shoalest part, extends across the channel, and will have to be removed for a sufficient depth and width to give a clear channel.

After getting outside there is no obstruction to be removed, but the shoal mentioned above as extending across from David's to Hunter's Island will regulate the draught which can be carried.

The Flat and Glen Islands have recently become quite a place of resort for summer excursions from New York City, and they are now connected by pile bridges, and a large amount of money has been expended in buildings and docks. On the east side of one of the Flat Islands a dock has been built, which is used for one of the landings. There is good water just at the dock, but a short distance northeast of it a small reef of rocks, marked "C," which is almost exposed at mean low-water, makes it difficult and sometimes dangerous to make this landing and get away from it. Its removal, though not necessary, would be a relief to navigation.

The estimate of the cost of the improvement is based on the plan of making a channel 100 feet wide and 8 feet deep at mean low-water between the Flat and Hunter's Islands, so that steamboats and large vessels need not turn in the narrow harbor, and to remove the "Corning Rock," so as to give a depth of 12 feet at mean low-water, and also to remove the rock marked "C," so as to give about 9 feet of water at mean low-water.

The survey was made by the party under the charge of Mr. Charles G. Weir, assistant engineer, under my supervision. The plane of mean low-water, to which the soundings have been reduced, was established by observation for two months on tide staffs located at the Neptune House dock in New Rochelle Harbor, and at the town dock on City Island. The results derived from the reduction of these observations is shown in tabular form on the accompanying chart.

A tracing of the original map of the survey in this locality, which was kindly furnished by Capt. C. P. Patterson, the Superintendent of the United States Coast and Geodetic Survey, has been of great service, and we are indebted to Captain Hooker, the manager of the excursions to Glen Island, for pointing out the rocks which required the closest examination.

ESTIMATE.

Removal of the "Corning Rock":		
150 cubic yards rock excavation, at $40	$6,000 00	
Engineering and contingencies	900 00	
		$6,900 00
Dredging inner channel and removing rock:		
45,000 cubic yards dredging, at 30 cents	13,500 00	
300 cubic yards rock excavation, at $20	6,000 00	
Engineering and contingencies	2,925 00	
		22,425 00
Removal of rock "C," east of Flat Island dock:		
400 cubic yards rock excavation, at $25	$10,000 00	
Engineering and contingencies	1,500 00	
		11,500 00
		40,825 00

All of the above is respectfully submitted by—
Your obedient servant,

R. H. Talcott,
Assistant Engineer.

Col. John Newton,
Corps of Engineers, U. S. A.

D 12.

IMPROVEMENT OF PORT CHESTER HARBOR, NEW YORK.

The result of the survey for the improvement of this harbor, directed by the river and harbor act, approved March 3, 1871, was reported December 28, 1871.

The improvements needed appeared to be the removal of "Sunken Rock," lying directly in the entrance to the harbor, and of "Salt Rock," in Byram Creek, in the path of vessels going up to Port Chester.

A breakwater from Byram Point, it was thought, would be of advantage to local commerce.

"Sunken Rock" has a depth over it of 5.7 feet at mean low-water, and it was proposed to remove it to a depth of 11 feet at mean low-water.

"Salt Rock" was exposed a little at mean low-water, and it was proposed to remove it to a depth of 9 feet at mean low-water.

The estimate was as follows:

Removal of Sunken Rock	$58,980 00
Removal of Salt Rock	12,652 00
Breakwater at Byram Point	25,000 00
	96,632 00

An appropriation of $12,000 was made in the river and harbor act, approved June 10, 1872, with which the removal of a portion of "Salt Rock," obstructing navigation, was effected by June, 1873.

As the next work, the removal of "Sunken Rock," would cost about $60,000, it was necessary to await another appropriation, which has not since been made, before undertaking anything more for this improvement.

1. In its original condition the channel was obstructed by "Sunken" and "Salt" rocks, the former with a depth over it of 5.7 feet at mean low-water, the latter slightly projecting above the level of mean low-water.

2. The originally adopted project for the improvement was the removal of these rocks and the construction of a breakwater.

3. The amount expended to the close of the fiscal year ending June 30, 1880, was $10,050.

4. The condition of the improvement was the removal of "Salt Rock" to a depth of 9 feet at mean low-water, leaving "Sunken Rock," a dangerous obstruction, untouched.

5. There has been no expenditure for the year ending June 30, 1881.

6. It is not proposed to expend anything during the fiscal year ending June 30, 1882, as the amount available, $1,950, is too small for operations.

7. The estimated amount required for the completion of the improvement of the harbor according to the adopted and approved plan is $84,632.

The amount of trade and commerce as reported in 1871, which has not probably increased since, was—

Number of trips up and down Byram River per year	760
Amount of tonnage	48,500
Value of cargoes	$1,800,000

Collection district, New York; nearest port of entry, New York; nearest light-house, Great Captain's Island.

Amount of revenue collected year ending June 30, 1881, $139,579,562.83; amount of commerce to be benefited by the completion of this work, ———.

ORIGINAL ESTIMATE.

Removing rocks and building breakwater	$96,632 00

AMOUNT APPROPRIATED.

By act approved June 10, 1872	$12,000 00
Amount expended	10,050 00

Money statement.

July 1, 1880, amount available	$1,950 00
July 1, 1881, amount available	1,950 00
Amount (estimated) required for completion of existing project	84,632 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	30,000 00

D 13.

IMPROVEMENT OF CANARSIE BAY, NEW YORK.

The survey of this bay, forming a part of Jamaica Bay, Long Island, was directed by the harbor and river act approved June 18, 1878, the results of which, with a project of improvement and estimates were submitted February 11, 1879.

The object was to connect Carnarsie Landing with the deep water of Jamaica Bay by means of a permanent channel of a depth of 6 feet at least at mean low-water.

To effect this result the project was to form a tidal basin inclosed by dikes, the filling and emptying of which should be through the proposed new channel.

A map showing the position and extent of the dikes was sent with the report.

The estimated cost was $88,000.

An appropriation of $10,000 was made by the harbor and river act approved June 14, 1880, and it was decided to apply it to the construction of a detached dike along the shallow dredged channel leading from Canarsie Landing to the deep water of Jamaica Bay, and at the mouth of this channel, with the idea of fixing this outlet in a permanent position, and thus concentrating the scour of the currents, such as they are, thereby removing a shoal or bar which obstructed ingress and egress between the Canarsie channel and the deep waters of Jamaica Bay.

A contract was made, November 11, 1880, with Henry DuBois & Sons for the construction of this dike, about 1,000 feet long, composed of two parallel rows of piles connected by cross-ties and tie-rods and filled in between the rows with stones. All the timber used was to be impregnated with dead oil of coal tar at the rate of 10 pounds to each cubic foot of timber. This work was completed June 27, 1881, and is reported to have had the effect designed of deepening the outlet of the Canarsie channel.

Under the grant of $5,000 made in the river and harbor act approved March 3, 1881, it is proposed to extend the diking so soon as the amount available shall be sufficient to construct the line from A to a point near Canarsie Landing, and on the side of the channel opposite to the constructed dike (see map). This need not be a dike of the ordinary construction; a strong line of sheet piling properly braced would suffice to receive and hold the currents in the channel, and thus lead to a permanent amelioration in depth, the timber to be creosoted.

The estimated cost is $14,000.

It is not unlikely, therefore, that with a limited project, short of that constituting the construction of a tidal basin, an adequate depth of water may be maintained; but, if not, the work constructed already, as well as that recommended in this report, may be made to form a part of the inclosure of a tidal basin of sufficient capacity to maintain an adequate channel.

1. The original condition of the channel leading to Canarsie answered to a depth of 4½ feet at mean low-water.

2. The originally adopted project was by the inclosure with dikes of a tidal basin, and no important amendments, alterations, or additions thereto have been made.

3. Nothing had been expended up to June 30, 1880.

4. The condition of the channel had not varied from its original status.

5. During the fiscal year ending June 30, 1881, there have been expended $9,639.93, and the dike constructed—no examination as yet having been made since its completion, June 27, 1881—is reported to have deepened the water over the bar or shoal at the outlet of the channel.

6. The amount that could be profitably expended during the fiscal year ending June 30, 1882, would be the estimated amount, not available, however, for the construction of a line of sheet piling along the south edge of the channel at Canarsie, with the object of collecting and concentrating the currents in that channel.

7. The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is $73,000.

During the summer a line of steamboats from Canarsie Landing connects New York and Brooklyn with Rockaway Beach, and ferry boats are run all the year to Barren Island, at Rockaway Inlet, where there are several large manufactories of fertilizers.

This work is in the collection district of New York. The nearest port of entry is New York City.

Amount of revenue collected during the last fiscal year, $139,579,562.83.

The nearest light-house, Fort Tompkins, Staten Island.

The amount of commerce and navigation to be benefited, unknown.

ORIGINAL ESTIMATE.

For dikes of creosoted timber	$88,000 00

AMOUNTS APPROPRIATED.

By act approved June 14, 1880	$10,000 00
By act approved March 3, 1881	5,000 00
	15,000 00
Amount expended	9,639 93

Money statement.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$15,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities, July 1, 1880		9,639 93
July 1, 1881, amount available		5,360 07
Amount (estimated) required for completion of existing project		73,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		9,000 00

Abstract of bids for construction of pile dike in Canarsie Bay, New York; opened October 29, 1880.

No.	Bidders.	Price per linear foot.	Remarks.
1	Swift & Aken	$10 47 13 40	For dike 5 feet wide. For dike 8 feet wide.
2	Henry DuBois & Sons	9 00	
3	Clinton Stephens	17 65	
4	James D. Leary	12 00	

Abstract of contract for construction of pile dike in Canarsie Bay, New York.

Contractor.	Residence.	Date of contract.	Subject of contract.	Remarks.
Henry DuBois & Sons ...	New York, N. Y. ..	Nov. 11, 1880	Constructing pile dike in Canarsie Bay.	To be completed June 30, 1881. Completed.

COMMERCIAL STATISTICS.

The Canarsie Railroad will receive this year by water about 1,000 tons of coal and iron.

The following vessels are owned at this place:

	No.	Tons.	Draught.
Schooners..	4	7 to 12 each.	3½ feet.
Sloops..	60	6 to 8 each.	1½ to 3½ feet.

The inhabitants look to an increase in business if the channel is restored to the condition in which it was some few years ago.

D 14.

IMPROVEMENT OF SHEEPSHEAD BAY, NEW YORK.

The survey of this bay was directed by the river and harbor act approved June 18, 1878, and the results of the survey, with a project of improvement and estimates of cost, were reported February 11, 1879.

Estimated cost, $100,000.

The sums appropriated for this improvement, amounting to $8,000, are insufficient for the commencement of operations upon any scale sufficient for permanent results. The portion to be undertaken, first of all, would be the outlet, which, at the date of the survey, had little over 2 feet in depth at mean low-water, being inferior in this respect to all other portions of the interior channel, except one where a short bulkhead across this channel is found.

The movement of Rockaway Inlet westward, should it continue, would interfere seriously with the present entrance to Sheepshead Bay, as also with any works constructed to increase its depth.

The better plan would be to make another examination with a view of determining a position for the outlet which would not likely be interfered with by the movement of Rockaway Inlet and attendant shoals.

1. The original condition of the navigable channel was, for the entrance a depth of little over 2 feet at mean low-water, and for the interior channel not less than 4 feet, except at two narrow bulkheads across said channel.

2. The originally adopted project, with a proviso, however, not to be commenced should the movement of Rockaway Inlet be likely to interfere, was to deepen the entrance by means of converging jetties, and to improve the interior channel by longitudinal dikes, so placed as in some instances to form tidal reservoirs for the scour of the channel.

3. Nothing had been expended up to the close of the fiscal year ending June 30, 1880.

4. The condition of things at the specified date was the same as that determined by the survey.

5. Nothing has been expended during the year ending June 30, 1881, and the state of things remains unaltered.

6. The amount of funds on hand are not sufficient for lasting improvement at any point, and therefore cannot be profitably expended prior to June 30, 1882.

7. The estimated amount for the entire and permanent completion of the work of improvement in accordance with the project approved and adopted (reserve being had of the probable movement of Rockaway Inlet), is $92,000.

This work is in the collection district of New York. The nearest port of entry is New York City.

Amount of revenue collected during the last fiscal year, $139,579,562.83.

The nearest light-house, Fort Tompkins, Staten Island.

The amount of commerce and navigation to be benefited is unknown.

ORIGINAL ESTIMATE.

For dikes of creosoted timber	$100,000 00

AMOUNTS APPROPRIATED.

By act approved June 14, 1880	$3,000 00
By act approved March 3, 1881	5,000 00
Total	8,000 00

Money statement.

July 1, 1880, amount available	$3,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$8,000 00
July 1, 1881, amount available		8,000 00
Amount (estimated) required for completion of existing project		92,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		10,000 00

D 15.

IMPROVEMENT OF SUMPAWAUMUS INLET, NEW YORK.

The survey of this inlet was directed by the act approved June 14, 1880, and the results of the survey, with a project for improvement and estimates of cost, were reported October 30, 1880.

The improvement recommended was to dredge a channel 150 feet wide at the mouth, 100 feet wide in the inlet, and 5 feet deep at mean low-water at an estimated cost of $23,115.

The amount, $5,000, appropriated by act approved March 3, 1881, is therefore insufficient for a beginning as there would be required at least $15,000 to make a channel of the required depth and 60 feet in width, which is the least that should be offered for navigable purposes. It was and is again recommended that the appropriation be reserved until additional grants shall render it feasible to commence operations.

1. The original condition of the channel was as to depth from 1 to 5 feet, and as to width from 30 to 600 feet.

2. The originally adopted project was to dredge a channel from 150 to 100 feet in width, and 5 feet deep at mean low-water; and this project has not been modified.

3. Nothing has been expended up to June 30, 1880.

4. The channel is in its original condition.

5. Nothing has been expended during the fiscal year ending June 30, 1881.

6. The amount available, $5,000, could not be profitably expended, for the reasons given, during the fiscal year ending June 30, 1882.

7. The estimated amount required to finish the project of improvement, as approved and adopted, is $18,115.

The amount of commerce by water is unknown; the gradual shoaling of the inlet seems to have diverted freights to the railway, and it is because of the rates charged by rail that complaints are heard and application has been made for the improvement of the inlet.

The village of Babylon, at the head of navigation, has a population of about 2,000, and it is estimated that about 5,000 people will be benefited by the improvement.

Babylon is frequented as a summer resort, and has several mills and factories; from the wharf at the mouth of the inlet there is steamboat communication with Fire Island during the summer. The amount of capital invested in business is stated to be between $2,000,000 and $3,000,000, and the amount of business done annually about $500,000.

This work is in the collection district of New York. Nearest port of entry, New York City. Nearest light-house is Fire Island.

The amount of revenue collected during the fiscal year ending June 30, 1881, was $139,579,562.83. The amount of commerce and navigation to be benefited by the proposed improvement is about $500,000.

ORIGINAL ESTIMATE.

67,000 cubic yards dredging, at 30 cents	$20,100 00
Engineering contingencies, &c	3,015 00
Total	23,115 00

AMOUNT APPROPRIATED.

By act approved March 3, 1881	$5,000 00

Money statement.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount available	5,000 00
Amount (estimated) required for completion of existing project	18,115 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	10,000 00

SURVEY OF SUMPAWAUMUS INLET, LONG ISLAND, NEW YORK.

UNITED STATES ENGINEER OFFICE,
New York, October 30, 1880.

GENERAL: The river and harbor act approved June 14, 1880, directs the survey of Sumpawaumus Inlet, Long Island, New York, which, having been finished, I have the honor to submit my report.

The survey was executed by the party of Mr. Charles G. Weir, assistant engineer, acting under the general supervision of Mr. R. H. Talcott, assistant engineer, who received from this office his instructions as to the nature and scope of the examination and special points necessary for indicating the mode of improvement.

I transmit herewith the map and report of Mr. R. H. Talcott, which, in so far as it describes the kind of improvement and the reasons therefor, was prepared under my personal supervision.

It is not likely that diking or training-walls will be required, and dredging alone would probably answer the purpose. The estimate to secure a channel of 5 feet in depth at mean low-water is about $24,000

The testimony, as far as we have it, shows that the depth has been continuously diminishing for a number of years, which is an unfavorable feature for the permanence of the channel, whether improved by dredging alone, or a combination with training-walls. Owing to the comparative absence of currents, the improved channel may retain an adequate depth for a number of years. On this point, however, there is no knowledge from experience for this locality which is available.

* * * * * * *

Respectfully submitted.

JOHN NEWTON,
Colonel of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. R. H. TALCOTT, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
New York, October 29, 1880.

GENERAL: I have the honor to submit the following report on the survey of Sumpawaumus Inlet, Long Island, with such information as I have been able to obtain in regard to the commerce and navigation of the same:

The accompanying chart shows the present condition of the inlet, and the work proposed for the improvement of the channel. An estimate of the probable cost of the latter is appended hereto.

Sumpawaumus Inlet is in the collection district of New York.

New York City is the nearest port of entry. The nearest light-house is Fire Island light, about six and one-half miles distant southeasterly.

The amount of revenue collected at New York City during the past fiscal year is $131,812,349.89.

The amount of commerce and navigation to be benefited by the proposed improvement is unknown.

The amount of tonnage for the past year is unknown.

Sumpawaumus Inlet is a tributary of the Great South Bay, and lies towards its western end. It is only an estuary and the supply of fresh water, which is large only after heavy rains, is stored in a pond and used for milling purposes. The water in the inlet is so shallow that only very light-draught boats can navigate it, and those now employed are nearly all pleasure boats for the use of summer residents. The expense of lightering the freights of larger vessels has driven them away, and all supplies are now brought by railroad, except those produced in the neighborhood.

The bed of the inlet for a greater part of its length is soft mud, varying in depth from two to four feet, and, according to the best information obtainable, the water is growing shallower every year.

Outside the inlet, except in shoal water near the shore, the bottom is all soft mud. Both the shores are marsh and unimproved, except near the head of tide-water and at the mouth.

The village of Babylon, which is at the head of navigation, has a population of about two thousand, but it is estimated that about five thousand inhabitants will be benefited by the improvement. Babylon is a great place of resort in summer, and has several mills and manufactories. From the wharf at the mouth of the inlet there is steamboat communication with Fire Island during the summer, and a horse railroad carries passengers and freight from the steamboat to the Long Island Railroad depot in the village The amount of capital invested in business is estimated at between $2,000,000 and $3,000,000, and the amount of business done annually at about $500,000.

The survey was made under my supervision by the party in charge of Mr. Charles G. Weir, assistant engineer, during the latter part of August and begining of September. The plane of reference was determined by observing the tides at the steamboat dock during one full lunation of day tides, and to the plane of mean low-water, as established by these observations, all the soundings have been reduced. The shore line and topographical features, so far as shown, were obtained from a tracing of a plane-table survey made by the United States Coast and Geodetic Survey, which was kindly furnished by Capt. C. P. Patterson, the Superintendent.

The rise and fall of the tides being so small, the currents in the inlet are not perceptible.

The plan proposed for the improvement is to dredge a channel giving 5 feet at mean low-water, from about the head of tide-water to the bay. In the inlet the width of the proposed channel is estimated at 100 feet. At its mouth the width increases to 150 feet, and keeps that width until the 5-foot contour is reached.

The increased depth of the channel will allow steamboats and propellers of light draught to navigate the inlet and thereby contribute to the permanency of the improvement.

ESTIMATE.

67,000 cubic yards dredging, at 30 cents	$20,100
Engineering, contingencies, &c	3,015
	23,115

Very respectfully, your obedient servant,

R. H. TALCOTT,
Assistant Engineer.

Col. JOHN NEWTON,
Corps of Engineers, U. S. A.

D 16.

IMPROVEMENT OF RARITAN RIVER, NEW JERSEY.

The act approved March 3, 1873, directed the survey of the Raritan River, the results of which with a project for improvement and estimates of cost were submitted by report of February 21, 1874.

The project contemplated dredging and diking at the "Stakes" and "Middle Ground," the removal of Rock Shoals at Whitehead's "Sand Dock" opposite "Martin's Dock," and a short distance below New Brunswick, together with dredging at other places as far up the river as New Brunswick, which was the limit proposed for improvement.

The estimate for a channel 8 feet deep at mean low-water and 200 feet wide, was $1,707,042.58, and for a depth of 10 feet and of same width, $2,093,662.05.

Mr. I. J. Wistar, general superintendent of canals leased by the Pennsylvania Railroad Company, under date of January 3, 1874, states in reference to the Delaware and Raritan Canal:

> The new lock at New Brunswick is used for laden boats, and the old one for light boats.
>
> It is considered that we now have a minimum depth of fully 8 feet throughout the canal.
>
> But the Chesapeake and Delaware Canal, over which a large quantity of through or joint traffic is passed, claims a depth of 10 feet.
>
> This company is now altering culverts, dredging canal bed, and otherwise preparing to make the same depth of 10 feet, whenever the adjacent rivers shall be in a condition to carry the same.
>
> A large amount of money has been already expended for this purpose in anticipation of improved river navigation, and such work is now in progress.

A first appropriation of $200,000 for the improvement of the Raritan, was made June 18, 1878.

Under this appropriation a contract, after due public advertisement, was made, November 18, 1878, with Messrs. Henry DuBois & Sons for the construction of about 12,800 linear feet of pile dike at the "Middle Ground" and "Stakes." The timber of the dike was to be all carbolized.

Also in the fall of 1878, dredges hired by the hour were put to work upon the shoals at the "Middle Ground" and "Stakes."

The small drilling scow having been refitted with a large Woodward pump, was used on the river above Whitehead's Sand Dock in boring on the water-jet principle to ascertain the character of the bottom and the presence of rock.

Another appropriation of $60,000 was granted March 3, 1879.

In December, 1879, 12,639.6 linear feet of diking had been finished by the Messrs. Du Bois completing their contract.

October 15, 1879, a contract was made with Mr. William H. Wood for the construction of a dike in Deep Bend opposite Crab Island, about 2,600 feet long, and of the extension down stream, for a length of about 2,200 feet, of the dike lying south of the channel at the "Stakes," the timber of the dikes to be carbolized.

By the last of November, 1879, the dredges had removed, in all, 268,315 cubic yards from the "Stakes."

Until the formation of ice in December, 1879, the dredges were kept at work upon the "Middle Ground," having excavated, altogether, from that part of the channel, 76,644 cubic yards.

In the month of June, 1879, a dredge was set at work upon the shoal at Whitehead's Sand Dock, and continued to the last of October, with the view of excavating what could be removed without resort to blasting.

There were taken up, in this way, 28,281 cubic yards of blue and red shale, small bowlders, and of very compact blue clay.

The small drilling scow continued the borings in the bed of the river as far up as the canal lock at New Brunswick. This work was finished in August, 1879, at which time 874 holes had been sunk, of an average depth of 4.1 feet, the holes varying from 1 to 12.6 feet in depth.

These borings enabled a revision of estimates to be made for the part of the river from Whitehead's Sand Dock to New Brunswick, which was reported in the annual report at the close of the fiscal year ending June 30, 1880:

For a depth of 12 feet at mean low-water	$2,399,820 00
For a depth of 10 feet at mean low-water	1,047,535 00

The drilling scow, after the completion of borings and the removal of some large bowlders which obstructed the channel a little above Martin's Dock, was taken to the reef at Whitehead's Sand Dock and kept constantly at work blasting and removing rock, except during the winter intermission, until the suspension of work in the early part of May, 1880.

On the resumption of work, in February, 1880, the dredges were employed in removing the rock which had been blasted and broken up in the fall before, and at the close of operations in May, had removed from the reef at Whitehead's Sand Dock 10,125 cubic yards of blasted rock and other material.

On April 15, 1880, Mr. Wood had finished the dike at Deep Bend, of the length of 2,600.6 feet.

By the act approved June 14, 1880, there was another appropriation, in these words:

> Improving Raritan River, New Jersey, one hundred thousand dollars; of which sum seventy thousand dollars shall be expended in the removal of rocks at Whitehead's Sand Dock, and thirty thousand dollars for dredging the shoals at the Middle Ground.

The specification of the objects to which the sum granted was to be applied, was certainly not required by any omission to attend to the particular localities named, for it will be seen that work had been commenced at the Middle Ground as early as the fall of 1878, and at Whitehead's Sand Dock as early as June, 1879.

Not only so, as the diking at the "Stakes" and at the "Middle Ground," which was a matter of first importance, had been finished, so in the natural order of improvement, the dredging of the Middle Ground and the removal of the rocky shoal at Whitehead's Sand Dock came next for completion, as rapidly as the money granted by Congress would avail.

The assignment, in the absence of advice from any known engineering source, of $30,000, for dredging the Middle Ground, was mere guess-work, whilst the application of $70,000 to the rock shoal at Whitehead's, where it could not possibly be expended for such operations in less than two years, has had the bad effect of tying up funds greatly needed for dredging and necessary incidental expenses, as the care of the dikes, &c.

It is always to be assumed that the Committee of Commerce, in preparing this piece of legislation, intended what was correct, but in departing from the common principle of taking information only from responsible and trustworthy sources, it has, unknowingly, been accessory to retarding the improvement.

The extension of the dike, south of the channel, at the Stakes, for the distance of 2,052½ feet, built under contract with William H. Wood, was completed and accepted September 15, 1880.

On October 15, 1880, a contract was made with John Van Patten, for dredging a channel on the Middle Ground, 200 feet wide, 12 feet deep at mean low-water, and about 5,300 feet long.

This work was not finished at the end of the fiscal year and the time of the contract was extended. No survey having been made as yet, the depth and width of the channel already finished is not known.

The small drilling scow recommenced the work of drilling and blasting in August, 1880, upon the rocky shoal at Whitehead's Sand Dock, and continued work until November 25, when it was laid up in winter-quarters.

Desirous of obtaining a more complete apparatus, the hydraulic scow formerly used on Diamond Reef for exposing the surface of the rock (as also for dredging purposes), by the use of the water-jet, combined with a current carrying off the *débris* through a large tube, was fitted in addition, with drills for use upon hard rock. By these means the bottom, when not hard enough to require to be blasted, could be excavated and the *débris* carried off, and the surface of the harder rocks cleared for drilling. Work was resumed in the latter part of March, and has since been steadily pursued. As the rock blasted has been allowed to accumulate in large quantities before being dredged, the condition of the new channel in respect to depth and width cannot now be specified.

The river and harbor act approved March 3, 1881, appropriates for—

> Improving Raritan River, New Jersey, twenty-five thousand dollars, of which sum twenty thousand dollars shall be expended on rocks at Whitehead's Sand Dock, and five thousand dollars at south channel, between Crab Island and South Amboy.

Here, as before, the assignment of a specific sum to the rocks at Whitehead's Sand Dock was mere guess-work and unsustained by information from any trustworthy source.

The character of the bed of the river is quite peculiar, composed within narrow limits of distance, of shale, clay, soft mud, oyster-beds, sand, gravel, bowlders, &c., and no reliance can be had upon the currents, however directed, for deepening or dredging a channel. So far as progress has been made it has been found necessary to dredge to obtain the requisite depth.

It will be seen from the map sent with this report that the currents of the ebb and flood are well guided and concentrated upon the channel by the dikes, and consequently there is every reason to believe will be efficient to maintain the depths gained.

1. The original condition of the navigation was an intricate channel at the "Stakes" of 7 feet at mean low-water and of 6.1 feet on the "Middle Ground," and of 7 to 8 feet at mean low-water upon the other shoals as far up as New Brunswick.

2. The originally adopted project was to dike and dredge at the "Stakes" and "Middle Ground" and to remove other shoals up to New Brunswick, so as to make a channel 200 feet wide and 10 feet, at least, deep, at mean low-water, and no modification has been made.

3. The amount expended to the close of the fiscal year ending June 30, 1880, was $233,453.43.

4. The condition of the improvement at that time was the completion of the dikes at the Stakes and Middle Ground except a distance of 2,053 feet at the lower end; a channel at the "Stakes," everywhere over 12 feet deep at mean low-water (except for a short distance where it has been dredged only to 9 feet at mean low-water), has also been obtained. Dredging had also been done at the Middle Ground, but not sufficiently for a marked improvement in depth. A considerable amount of dredging, bowlders, and rock were removed from the rocky shoal at Whitehead's Sand Dock.

5. There has been expended during the fiscal year ending June 30, 1881, the sum of $58,602.28. The diking has been completed at the "Stakes," dredging and rock blasting at Whitehead's, and dredging on the Middle Ground. No surveys have been made, and the state of the channel at the Middle Ground and Whitehead's is not known.

6. Of the balance, $92,944.29, there can be expended during the year ending June 30, 1882, only about $64,000, by which a channel, 12 feet deep at mean low-water, through the Middle Ground and of variable width, will be completed, and a channel of 100 feet in width and 12 feet in depth at Whitehead's, will be excavated.

7. The estimated amount required for the entire and permanent completion of the work of improvement, in accordance with the approved and adopted project, is $1,708,662.05.

This work is in the collection district of Amboy. Nearest port of entry, Perth Amboy Nearest light-house, Raritan Bay.

Amount of revenue collected for year ending June 30, 1881, ———.

Amount of commerce to be benefited by the completion of this work, ———.

ORIGINAL ESTIMATE.

For a 10-foot channel at mean low-water.

Dredging tidal basin, 648,000 cubic yards, at 40 cents	$259,200 00
Shoal, commencing 160 feet below New Brunswick locks, 2,399 cubic yards	78,767 85
Reef of rocks opposite Martin's dock, 4,672 cubic yards	182,208 00
Rocks 300 feet below New Brunswick locks, 2,399 cubic yards	76,768 00
Ledge of rocks 3,300 feet above Martin's dock, 17,504 cubic yards	542,624 00
Shoal below Widmar's dock, 14,400 cubic yards, at 35 cents	5,040 00
Reef of rocks covered with sand near Whitehead's dock, 11,509 cubic yards	497,188 80
Middle Ground, 55,555 cubic yards, at 35 cents	19,444 25
Stakes, 15,528 cubic yards, at 35 cents	5,434 80
Dike, 11,400 feet long, at $13.50 per running foot	153,900 00
Contingencies, 15 per cent. of the above	273,086 35
	2,093,662 05

REVISED ESTIMATE.

For excavating a channel 200 feet wide and 12 feet deep at mean low-water from 1,000 feet above Whitehead's Sand Dock to canal lock at New Brunswick.

From 1,000 feet above Whitehead's Sand Dock to Lawrence Creek:	
47,000 cubic yards of dredging, at $1	$47,000
From Lawrence Creek to 100 feet above Martin's dock:	
106,000 cubic yards of dredging at $1	106,000
From 1,000 feet above Martin's dock to end of steamboat dock:	
2,600 linear feet of crib dike, at $15	39,000
74,200 cubic yards of rock excavated, at $10	742,000
184,000 cubic yards of dredging, at $1	184,000
From end of steamboat dock to canal lock:	
94,100 cubic yards of rock excavation, at $10	941,000
27,800 cubic yards of dredging, at $1	27,800
Contingencies, engineering, &c	313,020
	2,399,820

For excavating a channel 200 feet wide and 10 feet deep at mean low-water from 1,000 feet above Whitehead's Sand Dock to the canal lock at New Brunswick.

From 1,000 feet above Whitehead's Sand Dock to Lawrence Creek:	
21,500 cubic yards of dredging, at $1	$21,500
From Lawrence Creek to 1,000 feet above Martin's dock:	
45,800 cubic yards of dredging, at $1	45,800
From 1,000 feet above Martin's dock to end of steamboat dock:	
2,600 linear feet of crib dike, at $15	39,000
4,700 cubic yards rock excavation, at $15	70,500
138,300 cubic yards of dredging, at $1	138,300
From end of steamboat dock to canal lock:	
56,800 cubic yards of rock excavation, at $15	568,000
27,800 cubic yards of dredging, at $1	27,800
Contingencies, engineering, &c	136,635
	1,047,535

AMOUNTS APPROPRIATED.

By act approved June 18, 1878	$200,000 00
By act approved March 3, 1879	60,000 00
By act approved June 14, 1880	100,000 00
By act approved March 3, 1881	25,000 00
	385,000 00
Amount expended	292,055 71

Money statement.

July 1, 1880, amount available	$100,000 00	
Amount appropriated by act approved March 3, 1881	25,000 00	
		$125,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	32,055 71	
July 1, 1881, outstanding liabilities	22,678 41	
		54,734 12
July 1, 1881, amount available		70,265 88
Amount (estimated) required for completion of existing project		1,708,662 05
Amount that can be profitably expended in fiscal year ending June 30, 1883.		50,000 00

Abstract of bids for dredging in Raritan River, New Jersey, opened October 7, 1880.

No.	Bidders.	Price per cubic yard in place.	Remarks.
1	John Van Patten	$0 24½	Accepted.
2	William Flannery	33	19 cents in scows.
3	John McDermott	39	30 cents in scows.

Abstract of contract for dredging in Raritan River, New Jersey.

Contractor.	Residence.	Date of contract.	Subject of contract.	Remarks.
John Van Patten.	Philadelphia Pa.	Oct. 15, 1880.	Dredging channel on "Middle Ground," Raritan River, N. J.	To be completed by June 30, 1881. Extension granted to August 30, 1881.

D 17.

IMPROVEMENT OF SOUTH RIVER, NEW JERSEY.

The survey of this river was directed by the act approved March 3, 1879, and the results of this survey and project of improvement, with estimates of cost, were reported January 23, 1880. Estimated total cost, $194,695.

South River is a tributary of the Raritan, which it enters by two courses, the one natural and the other artificial, 1¼ miles below the former.

The project has three divisions:

1. Of the portion below Little Washington, which includes a change in the outlet of the canal or artificial course of the river from its present direction at right angles to the course of the Raritan into one oblique to it, the closing of the natural course of the river below Petit's brick-yard, and increasing the depths by means of dikes and dredging to 8 feet at mean low-water up to Little Washington. Estimate, $72,162.
2. Of the portion from Little Washington up to Bissett's brick-yard, which includes a cut through the meadow-land, diking, and dredging to secure a depth of 6 feet at mean low-water, at an estimated cost of $93,783.
3. Of the portion from Bissett's brick-yard to Old Bridge, to secure a depth of 4 feet at mean low-water. Estimated cost, $28,750.

The act approved June 14, 1880, appropriated $40,000 for this improvement, which it was decided to devote to the section between the mouth and Little Washington.

As the change in the direction of the mouth necessitated an encroachment upon private property, certain persons of the neighborhood interested in the improvement procured the passage of a bill through the legislature of New Jersey appointing commissioners to condemn the land necessary for the object, the understanding of all concerned being that the United States should obtain the land free of cost. However, it was found that the course of the new outlet would cut the lands of one of the owners very disadvantageously to him, and time was fruitlessly spent in the endeavor to find a solution of the difficulty. About that time Messrs. Sayre & Fisher, who own the brick-yard along the Raritan below the junction of the South River Canal, offered to allow the government to cut off the corner of their dock at the junction of the two streams, and thus secure a direction to the outlet without special damage to any owner. This offer is conditioned upon constructing a wharf for the use of Messrs. Sayre & Fisher along the line cut off. Herewith is sent a sketch showing the original and present plans for changing the outlet.

As soon as the proper papers can be prepared and recorded, it is proposed, with the approbation of the department, to advertise for constructing the proper works for changing the outlet and for extending the improvement up the canal as far as available funds will permit.

1. The original condition of the navigable channels is: First, a false direction of the canal mouth, a depth there at mean low-water of 3½ feet; thence up to Little Washington, depths varying from 3.1 to 11.6 feet at mean low-water; thence to Bissett's brick-yard depths varying from 2.8 to 10.1 feet at mean low-water; and thence to Old Bridge, depths varying from 2.1 to 12.5 feet at mean low-water. There are also several sharp bends above Little Washington where it will be expedient to straighten the course occasionally by cuts.

2. The originally adopted project, which has not been modified, was: To change the outlet of the canal, to close the natural course of the river below Petit's, to dike and to dredge in order to obtain 8 feet at mean low-water up to Little Washington; thence, to straighten the course, dike and dredge up to Bissett's brick-yard, in order to obtain 6 feet at mean low-water; and finally, to straighten the course, dike, and dredge to Old Bridge, in order to obtain 4 feet at mean low-water.

3. There was no expenditures up to June 30, 1880.

4. The condition remained unaltered up to that time.

5. The sum of $382.20 was expended during the fiscal year ending June 30, 1881. The condition of the river remained the same.

6. The amount that can be profitably expended during the year ending June 30, 1882, is $45,617.80, the available balance, and it is proposed with this to construct a new outlet to the canal, to close the lower course of the river below Petit's, and to dike and dredge along the course of the canal.

7. The estimated amount for the entire and permanent completion of the work of improvement, in accordance with the approved and accepted project, is $148,695.

The amount of commerce to be benefited annually is represented to be 152,850 tons, of the value of $1,239,925, the principal articles of export being bricks, molding-sand, cord-wood, fruit, and vegetables.

On South River and tributaries there are represented to be:

8 brick works.
11 flour mills.
1 licorice mill.
4 snuff and tobacco manufactories.
2 shirt works.
6 saw-mills.
2 ship-yards.

All of the above in active operation.

This work is in the collection district of Amboy. Nearest port of entry, Perth Amboy. Nearest light-house, Raritan Bay.

Amount of revenue collected during the year ending June 30, 1881, ———.

Amount of commerce to be benefited by the completion of this work, ———.

ORIGINAL ESTIMATE.

Changing and deepening canal:		
10,000 cubic yards of dredging, at 30 cents	$3,000 00	
120,000 cubic yards of dredging, at 15 cents	18,000 00	
900 linear feet of half-dike, at $6	5,400 00	
1,700 linear feet of dike, at $8	13,600 00	
180 linear feet of dam, at $10	1,800 00	
		$41,800 00
From canal to Washington:		
17,000 cubic yards of dredging, at 15 cents	2,550 00	
2,300 linear feet of dike, at $8	18,400 00	
		20,950 00
Cut-off above Washington:		
6,000 cubic yards of dredging, at 30 cents	1,800 00	
40,000 cubic yards of dredging, at 15 cents	6,000 00	
900 linear feet of dike, at $6.50	5,850 00	
1,400 linear feet of half-dike, at $5	7,000 00	
		20,650 00

In front of brick-yards:		
15,000 cubic yards of dredging, at 15 cents	$2,250 00	
1,600 linear feet of dike, at $6.50	10,400 00	
		$12,650 00
From cut-off to Bissett's brick-yard:		
40,000 cubic yards of dredging, at 15 cents	6,000 00	
6,500 linear feet of dike, at $6.50	42,250 00	
		48,250 00
Above Bissett's brick-yard:		
2,000 cubic yards of dredging, at 15 cents	300 00	
700 linear feet of dike, at $6.50	4,550 00	
		4,850 00
New cut-off above Bissett's brick-yard:		
3,000 cubic yards of dredging, at 30 cents	900 00	
16,000 cubic yards of dredging, at 20 cents	3,200 00	
600 linear feat of dike, at $6.50	3,900 00	
900 linear feet of half-dike, at $5	4,500 00	
		12,500 00
At mouth of Tennent's Brook:		
2.000 cubic yards of dredging, at 20 cents	400 00	
500 linear feet of dike, at $6.50	3,250 00	
		3,650 00
From Tennent's Brook to Old Bridge:		
20,000 cubic yards of dredging, at 20 cents		4,000 00
Engineering, contingencies, &c		25,395 00
		194,695 00

AMOUNTS APPROPRIATED.

By act approved June 14, 1880	$40,000 00
By act approved March 3, 1881	6,000 00
	46,000 00
Amount expended	382 20

Money statement.

July 1, 1880, amount available	$40,000 00	
Amount appropriated by act approved March 3, 1881	6,000 00	
		$46,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		382 20
July 1, 1881, amount available		45,617 80
Amount (estimated) required for completion of existing project		148,695 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		20.000 00

Commercial statistics for the year ending December 31, 1880.

Items.	Tonnage.	Amounts.	Rate.	Value.
General merchandise	2,000			$850,000 00
Brick	90.000	40,000,000	$7 00	280,000 00
Coal	12,000		4 50	54,000 00
Wood	24,000	12,000 cords	5 00	60,000 00
Chestnut posts	15,000	35,000 posts	20	7,000 00
Hoop poles	300	50.000 poles	50 00	2,500 00
Telegraph poles	1,000	1,500 poles	3 00	4,500 00
Piles	800	800 piles	5 00	4,000 00
Fertilizers:				
coarse	25,000		2 00	50,000 00
guano	200		40 00	8,000 00
bone phosphates and bone	500		30 00	15,000 00
lime	3,000	100,000 bushels	08	8,000 00
Cement	300		9 00	2,700 00
Sand and clay	6,000		2 25	13,500 00
Lumber	700	700,000 feet		17,500 00
Farm products	7,500			160,000 00
Salt hay	3,000		12 00	36,000 00
Small fruits in crates	500	15,000 crates	4 50	67,500 00
Peaches	750	30,000 baskets	75	22,500 00
Apples	625	10,000 barrels	1 50	15,000 00
	193,175			1,677,700 00
Estimated value of production of mills and factories not enumerated above				1,737,600 00
Total				3,415,300 00

SAILING VESSELS, BARGES, AND STEAMBOATS.

Side-wheel steamboat	1
Propeller	1
Number of vessels owned (sailing)	48
Number of vessels, transient (sailing)	60
Number of barges, transient	50

Draught of water of the above vessels ranges from 5 feet to 9 feet.

D 18.

IMPROVEMENT OF CHEESEQUAKES CREEK, NEW JERSEY.

The survey of this creek was directed by the act approved March 3, 1879, and the results of the survey and a project for improvement from Raritan Bay to Whitehead's, a distance of 3 miles, with estimates of cost were reported December 23, 1879. Estimated cost $75,279.

The improvement was to consist of two parts. First, a change in the direction of the outlet, which by accumulations of sand formed by waves and currents is now forced in a direction nearly parallel with the beach, having a navigable depth over extensive flats of 1 foot at mean low-water. The course of the outlet will be changed and carried through the present beach by dredging a channel 200 feet wide nearly at right angles to its direction and 5 feet in depth at low-water: The new outlet will be sustained by two parallel jetties of stone, each about 1,500 feet long, and the existing outlet will be closed.

The navigation within the creek is to be improved by cutting off sharp bends and by dredging so as to secure a channel with a depth of 4 feet at low-water, and width of 100 feet as far up as Whitehead's.

By the act approved June 14, 1880, the sum of $20,000 was appropriated for this improvement, which it was decided to devote, as far as it would go, to the improvement of the outlet. As dredging the way for a new outlet would involve encroachment upon private property, the owner, Mr. David Noble Rowan, voluntarily offered the land to the government for the purpose of the improvement, and the papers in the case have been lately finished and recorded.

Proposals have been asked by public advertisement for the dredging of the new outlet, the closing of the present outlet, and the partial construction of the jetties.

1. The original condition of the channel over the bar or shoal at the mouth gives a depth of 1 foot at mean low-water; the channel in the creek has a depth of 4 feet at mean low-water for about ¾ of the length to be improved, and for the remaining portion a depth from 4 feet to 1½ feet at low-water; the course of the creek is very crooked and requires to be straightened.

2. The originally adopted project for the improvement was the change of the outlet into a direction at right angles to the beach; to sustain this direction by parallel jetties of stone, and to straighten the course of the creek and increase the depth in the upper portions thereof.

3. Nothing was expended to the close of the fiscal year ending June 30, 1880.

4. The condition of the creek and outlet at that date was unaltered.

5. The amount expended during the year ending June 30, 1881, was $129.82, and no alteration was made in the original condition of the outlet and creek.

6. The amount available, $19,870.18, can be profitably expended during the year ending June 30, 1882, in changing the direction of the outlet; in closing the present outlet, and in a partial construction of the jetties at the mouth.

7. The estimated amount required for the entire and permanent completion of the work of improvement in accordance with the approved and adopted project is $50,279.

The amount of commerce of Cheesequakes Creek is estimated by one of the parties interested at $110,000 per annum.

Among the exports are clay and molding sand, of the former 15,000 or 20,000 tons annually; and it is supposed by residents that the trade by water will be much increased after the navigation has been improved.

This work is in the collection district of Amboy, N. J. Nearest port of entry, Perth Amboy, N. J. Nearest light-house, Princess Bay.

Amount of revenue collected during the past fiscal year, ———. Amount of commerce to be benefited by this improvement is about $110,000.

AMOUNTS APPROPRIATED.

By act of Congress approved June 14, 1880	$20,000 00
By act of Congress approved March 3, 1881	5,000 00
Total	25,000 00
Amount expended	129 82

ORIGINAL ESTIMATE.

At mouth of creek:	
3,000 linear feet of timber foundation for jetties, at $4	$12,000
10,000 cubic yards of stone in jetties, at $1.75	17,500
50,000 cubic yards of dredging between jetties, at 16 cents	8,000
550 linear feet of pile-dike, at $6	3,300
Cut from New Landing to Forman's Dock:	
6,000 cubic yards of dredging, at 27 cents	1,620
32,000 cubic yards of dredging, at 16 cents	5,120
1,000 linear feet of pile-dike, at $6	6,000
Cut above Forman's Dock:	
4,000 cubic yards of dredging, at 27 cents	1,080
23,000 cubic yards of dredging, at 16 cents	3,680
300 linear feet of pile-dike, at $6	1,800
Deepening channel to Whitehead's Dock:	
11,000 cubic yards of dredging, at 16 cents	1,760
At mouth of Brick Creek:	
200 linear feet of pile-dike, at $6	1,200
Deepening channel of Stump Creek:	
15,000 cubic yards of dredging, at 16 cents	2,400
Engineering and contingencies, 15 per cent	9,819
	75,279

Money statement.

July 1, 1880, amount available	$20,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$25,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		129 82
July 1, 1881, amount available		24,870 18
Amount (estimated) required for completion of existing project		50,279 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		32,000 00

Statistics of commerce for year ending June 30, 1881.

Class.	Number.	Tonnage.	Draught.
Sloops	152	50 to 80 each	4 to 6 feet.
Schooners	30	80 to 200 each	4 to 7 feet.
Barges	146	100 to 300 each	5 to 7 feet.
Steam-vessels	232	Not known	

These vessels carry manure, gas-house lime, poudrette, &c., up the creek, and bring down fire and potter's clay, molding sand, cord-wood, bricks, and iron ore.

D 19.

SURVEY OF BRONX RIVER, OR WEST FARMS TIDE-WATER CREEK, FROM ITS MOUTH TO THE CITY OF NEW YORK.

UNITED STATES ENGINEER OFFICE,
New York, January 14, 1881.

GENERAL: I have respectfully to report upon the survey of the "Bronx River, or West Farms tide-water Creek, from its mouth in the city of New York," as provided for in the river and harbor act approved June 14, 1880.

The Bronx River is in the collection district of New York.
The city of New York is the nearest port of entry.
The nearest light-house is the North Brother Light.
The amount of revenue collected at New York during the past fiscal year was $131,812,349.89.

The amount of commerce and navigation to be benefited by the proposed improvement is not known, but the vessels navigating the river are very few, and most of the freighting is done by one propeller, and a few canal boats, loaded with coal.

Owing to the risk of navigating the creek, it is difficult to find a pilot to take charge of a vessel going up or down the river.

The creek empties into the East River by a shallow and tortuous channel winding through a mud flat, and obstructed by shoals varying in depth from 2.7 feet to 3.5 feet at mean low-water.

From the head of the projected dike to the rock 1,600 feet below the West Chester road, the depth is about 6 feet at low-water. Thence to the West Chester road, 3.3 feet to 5 feet. From the West Chester road to the gas-works the depth is from 3 feet to 2 feet at low-water. From the gas-works up for a distance of 2,400 feet the depth varies from 2 feet to 0 feet at low-water. Thence to the dam, about 1,100 feet farther up, the bottom is bare at low-water, with the exception of a small stream a few inches deep, which flows from the tail-race of the mill.

The Bronx is a tidal stream, as far up as the dam at West Farms. The rise and fall diminish somewhat after passing above the West Chester road bridge.

The amount of fresh water is large, but works are now under construction on the part of the city of New York to divert the main supply of this water for the use of the city. After the completion of these the amount of fresh water following the course of the creek will be greatly reduced.

It has been found very difficult to obtain a statement of the improvements needed for the purposes of commerce, either present or prospective, Appendix A* being the only one received, and the main object of any improvement being apparently to escape the rates charged for freight by the railroad.

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* Omitted. Printed in House Ex. Doc. No. 54, Forty-sixth Congress, third session.

For an improvement of the river it would be necessary to dredge and form a channel of 30 feet in width, and 4 feet deep at mean low-water, from the upper end of the present navigable portion, commencing say 2,400 feet above the gas-works to the West Chester road bridge.

In this section are several rocky ledges to be excavated, and the bottom is quite hard. The estimate for this section is $35,362.50.

From the West Chester road bridge the width of the channel should be made, for a distance of 1,600 feet down stream, 30 feet wide, and 5 feet deep at mean low-water; one ledge of rock at the lower end of this section should be removed. Estimate for this section $6,612.50.

Thence down to the proposed head of the dike, the present channel would need widening so as to give 5 feet of depth at mean low-water for a width of 40 feet. Some bowlders also would be removed. Estimate for this section, $4,025.

For the rest of the way, the improvement would consist in dredging a clear channel of 5 feet in depth, and supporting the same by a concave dike extending into deep water of the East River. Estimate for this section, $90,275.

The improvements most needed are probably those enumerated as of the first two sections of the creek.

The survey was made by the party under the charge of Mr. Matthew Cox, assistant engineer, under the supervision of Mr. R. H. Talcott, assistant engineer, whose report is forwarded herewith.

The plan of improvement was made under my supervision.

Respectfully submitted,

JOHN NEWTON,
Colonel of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. R. H. TALCOTT, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
New York, January 14, 1881.

GENERAL: I have the honor to submit the following report on the survey of the Bronx River, or West Farms tide-water Creek, New York City, with such information in regard to the commerce and navigation of the same as I have been able to obtain.

The accompanying chart shows the results of the late survey, and the works proposed for the improvement of the channel from the mouth of the river to near the head of tide-water. An estimate of the latter is hereto appended.

The Bronx River is in the collection district of New York.

New York City is the nearest port of entry. The nearest light-house is North Brother Light, on North Brother Island, in the East River.

The amount of revenue collected at New York City during the past fiscal year is $131,812,349.89.

The amount of commerce and navigation to be benefited by the proposed improvement is not known.

The amount of tonnage for the past fiscal year as reported by those engaged in business in the locality is 65,000 tons.

The Bronx River is a tide-water stream emptying into the East River. The tides extend as far as the dam in West Farms, but the rise and fall diminish somewhat after passing the West Chester road drawbridge. The supply of fresh water is quite large; but works are now under construction by the city of New York for diverting the main fresh-water supply for the use of the city. The dam and reservoir are some distance from tide-water, and there are several small streams which empty into the river below them, so that there will still be a limited amount of fresh water.

During a dry season like the past summer, the bed of the river is entirely bare at mean low-water for some distance below the dam, with the exception of a small stream a few inches deep which comes from the tail-race of the mill.

The depth of water in the channel at mean low-water is between 2 and 3 feet from the gas works to the railroad drawbridge, and the channel is both narrow and crooked. It is also obstructed by several rocky ledges which extend either partially or all the way across it. The bottom in this part is generally hard and composed of heavy gravel and cobble stones where it is not solid ledge rock. From the railroad bridge for about 1,600 feet below the West Chester road bridge there are several rocky ledges, and the easterly bank is almost all solid rock; but these ledges extend only part of the way across the channel, except the lower one, which extends entirely across. From this point for about 4,000 feet, there is a narrow channel of 6 feet depth, which has only a few bowlders to obstruct it. From this point to the mouth the channel widens considerably, and there are several bars with less than 3 feet at mean low-water. At the mouth the channel becomes crooked and undefined through a large mud flat, which is nearly a mile wide.

The banks of the river from the dam down to a short distance below the West Chester road bridge are mostly firm land or reclaimed marsh land, and sometimes rocky. The westerly bank for a considerable portion of this distance is protected by a stone wall which forms the dock front. For the rest of its course the banks are almost entirely marsh meadow.

The vessels navigating the river are very few, and most of the freighting is done by one propeller and a few canal boats loaded with coal. Owing to the dangers to navigation it is hard to find a pilot who will take the risk of carrying a vessel up or down the river.

The works for the improvement of the channel which are described below, with the exception of those at the lower end, will hardly be a permanent relief, but will probably last for several years, and are as follows: From a point near the upper end of the present navigable part of the river to the West Chester road bridge a channel 30 feet wide and 4 feet deep at mean low-water is to be excavated.

In this section there are several rocky ledges to be excavated, and the bottom is quite hard. From the West Chester road bridge the width of the channel will be 30 feet and the depth 5 feet for a distance of about 1,600 feet, where the last known ledge of rock which obstructs the channel is encountered. From this point to the beginning of the proposed dikes, as shown on the accompanying chart, the present channel is to be widened so as to give 5 feet depth at mean low-water for a width of forty feet, and some bowlders are to be removed.

The rest of the way the improvement will be to dredge a clear channel giving 5 feet at mean low-water for a width of 50 feet, and support it by a dike presenting a concave surface to the currents. At the upper end a parallel dike will also be required in order to narrow the channel-way sufficiently to keep the proposed depth.

The survey was made during the month of September by the party under the charge of Mr. Matthew Cox, assistant engineer under my supervision.

The plane of reference to which all the soundings have been reduced was obtained by observations of the tides at four points on the river. The results obtained from these observations is shown in tabular form on the accompanying chart.

ESTIMATE.

From near head of tide-water to West Chester road bridge:			
1,050 cubic yards rock excavation, at $20	$21,000 00		
13,000 cubic yards dredging, at 75 cents	9,750 00		
		$30,750 00	
Engineering and contingencies		4,612 50	
			$35,362 50
From West Chester road bridge 1,600 feet south:			
200 cubic yards rock excavation, at $20	$4,000 00		
3,500 cubic yards dredging, at 50 cents	1,750 00		
		5,750 00	
Engineering and contingencies		862 50	
			6,612 50
From 1,600 feet south of West Chester road bridge to dikes:			
7,000 cubic yards dredging, at 50 cents		3,500 00	
Engineering and contingencies		525 00	
			4,025 00
From beginning of dikes to East River:			
8,500 linear feet of dike, at $8	$68,000 00		
30,000 cubic yards of dredging, at 35 cents	10,500 00		
		78,500 00	
Engineering and contingencies		11,775 00	
			90,275 00
			136,275 00

All of which is respectfully submitted by your obedient servant,

R. H. TALCOTT,
Assistant Engineer.

Col. JOHN NEWTON,
Corps of Engineers, U. S. A.

D 20.

SURVEY AND EXAMINATION OF HEMPSTEAD HARBOR, LONG ISLAND, NEW YORK.

UNITED STATES ENGINEER OFFICE,
New York, December 29, 1880.

GENERAL: I have the honor to report upon the survey and examination of Hempstead Harbor, Long Island, New York, as provided for in the river and harbor act approved June 14, 1880.

The survey was made by the party of Mr. C. G. Weir, assistant engineer, under the general supervision of Mr. R. H. Talcott, assistant engineer, to whom was indicated from this office the essential points to be examined.

From information collected from parties interested, the proposed improvement will be principally in the inner bay, which, but for a narrow channel of communication, would be entirely separated from the outer bay by a low level of sand beach extending from the west shore and called "Bar Beach."

I respectfully refer to Appendixes A* and B* as enumerating the wants of the locality and the benefits to be derived from improving the navigable depth. The chart and Mr. Talcott's report are also transmitted, the latter discussing various possible modes of improvement, and prepared in this office after full consultation with me and under my supervision.

The method of improvement by separating the inner from the outer bay by a dam, and regulating ingress and egress by means of a lock, I cannot recommend. A beautiful sheet of water in front of the villas adorning the east shore and sufficiently deep for commercial purposes to the head of the bay would be formed. There are many serious objections to this plan. It would be costly as well as not necessary for the purposes of trade. Large accumulations of drift sand would continually shoal up the entrance to the lock and require frequent removals, and finally vessels could not use the lock during a storm from the north to northwest or seek a needed shelter in the inner bay. Approximate estimated cost, $440,000.

The second method would be to construct a dike from the "Bar Beach," in a general southerly direction, reaching nearly as far up as Hicks' Wharf.

This dike, 7,500 feet long, with 1,700 feet of half-dike, and the requisite dredging, would obtain and maintain a channel of 8 feet in depth at mean low-water as far up as half-way between the steamboat dock and Hicks' Dock.

The remainder of the channel dug to the southern extremity of the bay, and 4 feet deep at mean low-water, would probably require renewed dredging from time to time to keep it open.

ESTIMATE.

7,500 feet of dike, at $10	$75,000
1,700 feet half dike, shore protection, at $5	8,500
95,000 cubic yards of dredging, at 30 cents	28,500
From steamboat dock to head of bay, 100,000 cubic yards of dredging, at 30 cents	30,000
Engineering and contingencies	21,200
	163,200

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*Omitted. Printed in House Ex. Doc. No. 48, Forty-sixth Congress, third session.

This method of forming a tidal basin by means of a dike and generating a constant scour through a long reach of the channel, is undoubtedly the most feasible means of improvement; but, as in some other localities, it will be objected to upon esthetic principles, as marring the picturesque appearance of an uninterrupted sheet of water, and as offering, besides, an impediment to the free tacking of small sail-boats.

It is always difficult and generally impossible so reconcile the conditions of beauty with those of the interests of navigation, and it is not perceived how diking in one form or other could be entirely dispensed with except by the alternative construction of a costly dam and lock.

The long dike may be terminated at "A," the 8-foot channel at the steamboat dock, and an excavation 4 feet deep extending thence to the town dock, at a total estimated cost of $94,300.

The 4-foot channel would require dredging from time to time.

The Glen Cove landing in the lower bay is difficult of approach at low-water on account of a shoal there. As this is a permanent and natural shoal, which will return if removed by dredging, the proper remedy would appear to be for the proprietors to extend their dock into deeper water.

Hempstead Harbor is in the collection district of New York.

New York is the nearest port of entry. The nearest light-houses are Sand's Point light and Execution Rocks light, on Long Island Sound.

The amount of revenue collected at New York during the past fiscal year is $131,812,349.89.

The amount of commerce and navigation to be benefited by the proposed improvement is estimated (by those interested) at about $475,000, and the amount of tonnage for the past year, on the same authority, at 28,500 tons.

Respectfully submitted.

JOHN NEWTON,
Colonel of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. R. H. TALCOTT, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
New York City, December 27, 1880.

GENERAL: I have the honor to submit the following report of the survey of Hempstead Harbor, New York, together with such information in regard to the commerce and navigation of the same as I have been able to obtain.

The accompanying chart shows the present condition of the channel in the inner harbor and its connection with deeper water in the outer harbor as developed by the recent survey, and also the works proposed for the improvement. An estimate of the probable cost of carrying out either of three proposed plans is hereto appended.

Hempstead Harbor is in the collection district of New York.

New York City is the nearest port of entry. The nearest light-houses are Sand's Point light and Execution Rocks light, on Long Island Sound.

The amount of revenue collected at New York City during the past fiscal year is $131,812,349.89.

The amount of commerce and navigation to be benefited by the proposed improvement, as estimated by those interested, is said to be about $475,000.

The amount of tonnage for the past year is reported to be about 28,500 tons.

Hempstead Harbor lies on the north side of Long Island, about 8 miles east of Fort Schuyler, on Throgg's Neck. The bay is divided into two parts by a narrow neck of low sand beach called "Bar Beach," which runs out from the western shore nearly at right angles to the same and extends about ⅔ of the way across. The outer harbor has a good deep channel, but the inner harbor is very shoal, and the channel is very crooked. The upper part of the inner harbor is entirely bare some time before low-water, even in ordinary tides.

The village of Roslyn lies at the head of the inner harbor, and is the port from which quite a number of towns in the interior, such as Hempstead, Garden City, &c., draw their supplies of coal, lumber, bricks, and heavy merchandise. It has several manufactories, and a large trade in the products of the adjoining farms.

The present reliable means of communication with market in New York City is by railroad and one steamboat which makes a round trip daily between Roslyn and New York City. All heavy material brought in deep-draught vessels has now to be lightered from the outer harbor at a great increase in cost of transportation, and frequently heavy demurrage owing to high winds preventing the lighter from being used.

The inner harbor would also be used as a harbor of refuge for vessels engaged in transporting freights to the landings in the outer harbor in case of heavy storms, but these are now prevented from getting the benefit of a safe anchorage unless they are of very light draught.

The ground rises quickly from the shores of the bay, and in some places the bluffs come to high-water mark. As these bluffs are sandy, when there is a high wind, or when a steamboat passes, the waves undermine them and bring the sand into the channel. One of the worst places of this sort is just south of the entrance into the inner harbor. Here the currents are very strong and the channel close in shore, so that the steamboat waves have a direct action on the bluff. The sand brought into the channel at this point is, on a flood-tide, carried up the harbor, where it is deposited by the slackening currents and forms bad bars.

In studying the chart for the purpose of designing a permanent improvement, the method by dikes and dredging is the one suggested as the best and cheapest, but owing to the dikes being unsightly at low-water it has been suggested, by those having country residences in the vicinity, that a draw could be constructed across the present entrance and a lock used for ingress and egress, the water in the inner harbor being maintained at or near its present high-water level. This method, though a very expensive one and entailing a constant outlay in repairs and attendance, has been considered, and a rough estimate of its probable cost is submitted.

There being no data as to the foundation obtainable, no borings having been made, the cost of that item has been assumed and the cost of the lock has been obtained from estimates of similar structures on the Mississippi and Kanawha Rivers, without going into the details.

The second method of improvement, which is to dredge a channel and to build a dike to maintain it, would necessitate the widening of the present channel for some distance from the entrance into the inner harbor, and the dredging of a new channel through the shoals. From the entrance to the steamboat dock at Roslyn this channel is estimated as 200 feet wide and 8 feet deep at mean low-water, and thence to the wharves in the creek at the head of the harbor as 100 feet wide and 4 feet deep at mean low-water. The diking proposed would start from the southerly side of Bar Beach and extend about 7,500 feet up the and about parallel to and 800 feet from the easterly shore. This dike would form a tidal basin of the portion of the bay west of it, and give sufficient velocity to the currents in the channel to keep it scoured out to the required depth.

The third method is to dredge the present channel to a uniform depth of 8 feet at mean low-water and 150 feet wide.

Where the channel curves to the right and now shows such a tendency to shoal, two dikes would be required, one on the easterly side of the channel, following its present direction, and the second on the westerly side, overlapping the first and curving to the left.

In the event of the adoption of either of the two last-mentioned plans of improvement the protection of the shore near the entrance to the inner harbor will be necessary. This will require 1,700 feet of half dike.

The dikes required are estimated to be built of carbolized timber and according to the general plan now in use.

The survey was made during the past season by the party under the charge of Mr. C. G. Weir, assistant engineer, under instructions from this office.

The plane of mean low-water to which the soundings have been reduced, was established by tidal observations at the Glenwood dock at the entrance to the inner harbor, and at the Roslyn steamboat dock. The results of the reduction of these observations are shown in tabular form on the accompanying chart.

ESTIMATES.

First method.

1 lock 250 feet long, 60 feet wide, including gates, foundation, &c	$300,000	
1 dam	82,000	
		$382,000
Engineering and contingencies		57,300
		439,300

Second method.

From entrance to steamboat dock, 7,500 linear feet of dike, at $10	$75,000	
1,700 linear feet, half dike, at $5	8,500	
95,000 cubic yards dredging, at 30 cents	28,500	
		$112,000
From steamboat dock to creek, 100,000 cubic yards dredging, at 30 cents		30,000
Engineering and contingencies		21,300
		163,300

Third method.

From entrance to steamboat dock, 2,500 linear feet of dike, at $10	$25,000	
1,700 linear feet of half dike, at $5	8,500	
30,000 cubic yards of dredging, at 30 cents	9,000	
		$42,500
From steamboat dock to creek, 100,000 cubic yards of dredging, at 30 cents		30,000
Engineering and contingencies		10,875
		83,375

Respectfully submitted.

R. H. TALCOTT,
Assistant Engineer.

Col. JOHN NEWTON,
Corps of Engineers, U. S. A.

D 21.

EXAMINATION AND SURVEY OF THE WATER WAY CONNECTING JAMAICA BAY WITH CORNELL'S LANDING, IN THE STATE OF NEW YORK.

UNITED STATES ENGINEER OFFICE,
New York, December 18, 1880.

GENERAL: I have respectfully to report upon a survey and examination of the water-way connecting Jamaica Bay with Cornell's Landing, in the State of New York, as provided in the river and harbor act approved June 14, 1880.

The survey was made by the party of Mr. C. G. Weir, assistant engineer, under the supervision of Mr. R. H. Talcott, assistant engineer, who was furnished from this office with specific instructions for the collection of such data as would have an important bearing upon a practicable scheme of improvement; and, amongst others, to estimate the contents of a marsh tidal basin existing north of the dam at Cornell's Landing.

The chart of the survey and Mr. Talcott's report, herewith submitted, furnish all the material facts needed in the case.

The navigable depth at mean low-water is, in the creek, less than 1 foot. From its mouth to the 6-foot curve in the bay, the depth, though deeper generally, is diminished by a shoal to 1 foot. The mean rise and fall of tides is 4½ feet.

It appears from information collected from various parties that the depth at a former period was greater than at present; and its decrease is by them referred to the land waters having been diverted from their natural course into the reservoirs of the water-works of Brooklyn.

The tidal reservoir of the body of the creek is very small, even with the addition of the marsh reservoirs north of the old mill-dam. It would be expedient, however, that the remains of the dam be removed, to obtain a freer flow beyond, with the probable useful effect of affording a place of deposit for the silt brought up by the flood-tide, and of better preserving the depth at the Landing.

What appear to embarrass the navigation of the creek fully as much as the want of water are the sharp bends in connection with a width generally not much exceeding 60 feet.

Considerable relief would be afforded, besides removing the remains of the dam, by straightening the course of the channel, and dredging, so as to afford a uniform depth at mean low-water of at least 2 feet. The estimated cost for these operations would be about $30,000, and a reasonable degree of permanence would be secured.

A depth of 6 feet at mean low-water from the 6-foot curve of the bay to the Landing could be secured by dredging the creek, by diking and partial dredging along the line from the mouth of the creek to the 6-foot curve of the bay, by straightening the course of the creek and removing the remains of the dam, at an estimated cost of $94,000.

As the velocity of the tidal currents would be very little, a reasonable degree of permanence would be maintained.

Cornell's Landing is in the collection district of New York.

New York City is the nearest port of entry.

The nearest light-house is Sandy Hook light.

The amount of revenue collected at New York City during the past fiscal year is $131,812,349.89.

The present commerce by water which would be benefited by the proposed improvement is reported as very small. The desire of escaping the alleged high charges of freight by rail seems to constitute the basis of the demand for an improvement of navigation.

I respectfully refer to copies of papers furnished as to the resources of the neighborhood, marked A and B, and appended.*

Respectfully submitted.

JOHN NEWTON,
Colonel of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. R. H. TALCOTT, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
New York, December 15, 1880.

GENERAL: I have the honor to submit the following report of the survey of the water-way from the channel of Jamaica Bay to Cornell's Landing, New York, with such information in regard to the commerce and navigation of the same as I have been able to obtain.

The accompanying chart shows the present condition of the water-way, and the works proposed for the improvement of the same. An estimate of the probable cost of these works is appended hereto.

Cornell's Landing is in the collection district of New York.

New York City is the nearest port of entry.

The nearest light-house is Sandy Hook light.

The amount of revenue collected at New York City during the past fiscal year is $131,812,349.89.

The amount of commerce and navigation to be benfited by the proposed improvement is unknown.

The total tonnage of the past fiscal year is reported to be about 1,000 tons. Cornell's or Three-mile Creek is a tributary of Jamaica Bay, and is the only water-way by which vessels can approach the village of Jamaica. The channel of the navigable part of the creek is through salt marsh, and has several very sharp bends. At Cornell's Landing, the head of navigation of the creek, there are the remains of an old dam and tide-mill, which have been allowed to fall into decay. Above this dam there is quite a large area of low marsh land, which is overflowed by the ordinary tides, and this area was used formerly for the storage of the water for the mill power. The dam is now very dilapidated and obstructs the full flow of the tides into the basin above. Before the construction of the Brooklyn water-works there was quite a good supply of fresh water, but this had been diverted, and now the supply is very limited. At the time of the building of the Brooklyn water-works most of the materials used for the construction of the dams, conduits, &c., were brought by water to Cornell's Landing, and it is said by those long resident in the vicinity that previous to the diversion of the fresh water and the disuse of the tide-mill the depth of water in the channel of the creek was considerably greater than at present, and that quite a number of schooners were engaged in bringing coal and fertilizers to Cornell's Landing. Now only one or two small sloops are used in this traffic. In addition to the small depth of water, the sharpness of the bends in the creek forms a serious obstruction to navigation, and several times canal boats and barges have been sunk in the attempt to get around them while loaded with material for the Brooklyn water-works.

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* Omitted. Printed in House Ex. Doc. No. 17, Forty-sixth Congress, third session.

The proposed improvement is only intended to relieve the present difficulties in the navigation by straightening the creek in places where the channel is excessively crooked by cutting new channels through the marsh. The banks of the creek are now so firm and stand so well, it is to be supposed that the new channel will not require any protection to the slopes, but an allowance is made for a partial protection in the estimate.

It being very doubtful whether a much greater depth at mean low-water than there is at present can be maintained for any length of time, it is not proposed to deepen the channel where there is now as much as 2 feet, or to make any improvement in the channel from the mouth of the creek to deeper water in Jamaica Bay, except sufficiently to give a uniform depth of 2 feet at mean low-water, this being considered unadvisable until by experiment it is found that the depth in the creek can be permanently improved. Having the above in view, it is proposed to remove the remains of the old dam, so as to give a clear water-way for the tides to flow in and out of the overflowed area above it. From a point just below the end of the dock at the Landing, instead of following the present bed of the creek, it is proposed to cut a new channel through the marsh and enter the old channel again below the bend. This cut will be about 500 feet long and 60 feet wide. At the next bend below a cut about 650 feet long and 70 feet wide would avoid two elbows in the channel. Where this cut enters the old channel the creek takes another sharp turn. Instead of using the old channel a cut of 450 feet length and 70 feet width is proposed, which will enter the old channel at the mouth of the creek. These new channels are to be dredged to the depth of 2 feet at mean low-water, which, with the rise of tide, will give over 6 feet at high-water, and admit loaded canal-boats to pass.

The accompanying chart is compiled from soundings taken by the party under the charge of Mr. C. G. Weir, assistant engineer, during the past season, and from a tracing of a survey made by the United States Coast and Geodetic Survey in July last, which has been kindly furnished by Capt. C. P. Patterson, the Superintendent.

ESTIMATE.

Cut through bend below landing:		
3,000 cubic yards dredging, at 40 cents	$1,200	
6,000 cubic yards dredging, at 30 cents	1,800	
400 linear feet half dike, at $5	2,000	
100 linear feet full dike, at $8	800	
		$5,800
Cut through second bend:		
4,000 cubic yards dredging, at 40 cents	1,600	
10,000 cubic yards dredging, at 30 cents	3,000	
600 linear feet half dike, at $5	3,000	
250 linear feet full dike, at $8	2,000	
		9,600
Cut through bend at mouth:		
2,500 cubic yards dredging, at 40 cents	1,000	
7,000 cubic yards dredging, at 30 cents	2,100	
400 linear feet half dike, at $5	2,000	
200 linear feet full dike, at $8	1,600	
		6,700
Deepening old channel to 2 feet at mean low-water:		
13,000 cubic yards dredging, at 30 cents		3,900
		26,000
Contingencies, engineering, &c		3,900
		29,900

Respectfully submitted.

R. H. TALCOTT,
Assistant Engineer.

Col. JOHN NEWTON,
Corps of Engineers, Brevet Major General, U. S. A.

D 22.

SURVEY OF PATCHOGUE RIVER, NEW YORK.

UNITED STATES ENGINEER OFFICE,
New York October 30, 1880.

GENERAL: The river and harbor act approved June 14, 1880, directs the survey of "Patchogue River, New York," which having been finished, I have the honor to submit my report.

The survey was executed by the party of Mr Charles G. Weir, assistant engineer, acting under the general supervision of Mr. R. H. Talcott, assistant engineer, who received from this office his instructions as to the nature and scope of the examination, and special points necessary for indicating the mode of improvement.

I transmit herewith the map and report of Mr. R. H. Talcott, which, in so far as it describes the kind of improvement and the reasons therefor, was prepared under my personal supervision.

There is little or no current in the river, and dredging alone is recommended for the improvement as far down as the outlet into Great South Bay, beyond which, in order to preserve the channel, once formed, from the action of waves, lines of parallel dikes will be necessary.

The estimate to secure a depth of 6 feet at mean low-water by dredging in the river, and from its mouth to the 6-foot curve in the bay, is	$21,000
For diking from river to 6-foot curve in the bay	15,800
Engineering, contingencies, &c., 15 per cent	5,520
	42,320

* * * * * * *

Respectfully submitted.

JOHN NEWTON,
Colonel of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. R. H. TALCOTT, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
New York, October 29, 1880.

GENERAL: I have the honor to submit the following report of the survey of Patchogue River, Long Island, with such information in regard to the commerce and navigation of that stream as I have been able to obtain. The accompanying chart shows the results of the survey and the works proposed for the improvement of the channel. An estimate of the proposed cost of the latter is also appended.

Patchogue River is in the collection district of New York.

New York City is the nearest port of entry. The nearest light-house is Fire Island light, about 14 miles distant southwesterly.

The amount of revenue collected at New York City for the past fiscal year is $131,812,349.89.

The amount of commerce and navigation to be benefited by the proposed improvement is about $150,000, and the tonnage for the past year about 1,500. The latter figures are from information furnished by Mr. Charles R. Smith and others, who are residents of Patchogue.

Patchogue River is a tributary of Great South Bay, which it enters not far from its eastern end; it has quite a large drainage area, the water from which is stored for milling purposes by a dam a short distance above the navigable part of the stream. This dam has given way once or twice, and brought large quantities of sand and gravel into the lower section of the river.

The extreme shallowness of the water, both at the mouth and in the river, will admit of boats of only very light draught, and consequently the tonnage is very small, and though vessels drawing 6 feet can come within a short distance of the mouth the anchorage is so exposed and bad they cannot safely lie there in stormy weather.

The bed of the river is soft mud, and the eastern banks marshy. The greater part of the western bank is good firm ground and has been docked and improved. Outside where the depth is less than 6 feet the bottom is hard sand.

The village of Patchogue has a population of over 3,000; it is a place of summer resort, has several mills and manufactories, and a large fish and oyster trade, in which latter about 200 vessels are engaged. At present nearly all supplies, except those which the neighborhood furnishes, are brought by railroad.

The survey was made under my supervision in the month of September, by the party in charge of Mr. Charles G. Weir, assistant engineer. Tides were observed at the mouth of the river, during progress of the survey. The mean low-water reading of the tide-staff, to which all the soundings have been reduced, was obtained by a line of levels connecting the tide-staff with a bench-mark established by the United States Coast and Geodetic Survey. The location and elevation of this bench-mark were kindly furnished by Capt. C. P. Patterson, the Superintendent, to whom we are also indebted for a tracing showing the shore line and topography in that vicinity.

Some years ago an improvement of the mouth of the river was attempted by means of a dike, but this being a light structure, it has been badly damaged by ice and storms, and only a small section of it is of any use at present. The improvement proposed is to dredge a channel 100 feet wide and giving 6 feet at mean low-water all the way from the present head of navigation to the bay. In the river, as there is such a small rise and fall of tide, there are no perceptible currents, and a dredged channel will maintain itself for a long time, but outside, owing to the drift of the sand, a dike on the west side of the proposed cut will be necessary for its full length, and probably a shorter one on the east. The dikes proposed are to be of carbolized timber according to the general plan and to be filled with rubble stone. The width from out to out of piling will vary from 5 to 7 feet, according to the depth of the water.

The lines of dredging and diking as proposed are shown in blue upon the chart.

ESTIMATE.

From head of navigation to mouth of river:		
46,000 cubic yards of dredging, at 30 cents		$13,800
From mouth of river to 6-foot contour:		
1,700 linear feet of diking, at $6	$10,200	
700 linear feet of diking, at $8	5,600	
24,000 cubic yards of dredging, at 30 cents	7,200	
		23,000
Engineering contingencies, &c		5,520
		42,320

Very respectfullly, your obedient servant,

R. H. TALCOTT,
Assistant Engineer.

Col. JOHN NEWTON,
Corps of Engineers, Brevet Major-General, U. S. A.

D 23.

REPORT UPON A PROJECT OF MR. HENRY KNAPP, CIVIL ENGINEER, FOR CREATING A PERMANENT DEEP CHANNEL THROUGH SANDY HOOK BAR, PORT OF NEW YORK.

OFFICE OF BOARD OF ENGINEERS FOR FORTIFICATIONS,
AND FOR RIVER AND HARBOR IMPROVEMENTS, &C.,
New York, November 30, 1880.

GENERAL: The Board of Engineers for Fortifications and for River and Harbor Works, to whom was submitted from the office of the Chief of Engineers, of date June 10, 1880, certain papers relating to a project for creating a permanently deep, wide, and straight channel through the Sandy Hook Bar of the port of New York, for the purpose of forming an improved commercial outlet, have the honor to report as follows:

House bill 3042, Forty-sixth Congress, second session, stating in the title the object as above described, was transmitted to the honorable Secretary of War from the Committee on Commerce of the House of Representatives for consideration of the practicability of the plan on which the proposed improvement is based. And inasmuch as the bill did not set forth or sufficiently explain the project of the originator, Mr. Henry F. Knapp, civil engineer, it was suggested by the Chief of Engineers in his letter committing the subject to the Board, that Mr. Knapp be invited to offer such information regarding his plan as would enable the Board to give it due consideration, with the view of complying with the requirements of the Committee on Commerce. This having been done, Mr. Knapp forwarded to the Board a communication, marked A, dated August 3, 1880, and appended to this report. Subsequently, after an interview with the Board, in which the plan was discussed, he submitted another paper, marked B, of date of October 21, 1880, also appended.

The project as delineated on the Coast Survey chart of 1875, and further described in the papers submitted, is a wall extending partly across the entrance to the harbor in deep water outside the bar, the top varying from 40 to 71 feet below mean low-water. The plan of the wall is a circular arc 5 miles and 950 yards long, presenting its convexity to the bar and described with a radius of 11 miles. The general direction is WSW. ¼ W. The extremities are held at considerable distances from the shores of Long Island and of New Jersey, and the wall is founded in a depth of 10 fathoms at its NE., and of 16 fathoms at its SW. end. The structure may be increased or diminished in length according to the effect produced, and it is intended by the originator to maintain a channel 31½ feet deep at mean high-water, and 500 feet at least in width by the means of the wall alone without resort to dredging, to shutting off any existing channel, or to decreasing the present width of the entrance.

The height as prescribed by the originator would, in his opinion, permit the largest class of vessels to pass over its top without striking, and he claims furthermore that it will act as a breakwater behind which vessels could anchor in as perfect security from the force of the waves as in the space behind the bar.

Mr. Knapp enumerates three influences at work by which the bar is retained in its present position, extent, and depth, viz, 1st, the force of the sea waves acting on the sandy bottom outside the harbor to heave sand into the mouth and close it up by forming a bar across it; 2d, the force of the outflowing currents antagonistic to the first named, and cutting out the channel; 3d, the littoral or shore currents which sweep across the harbor outside the bar, at the rate, as stated by him, of from 1 to 2½ knots per hour, and supposed to be most effective in sweeping away from the outside of the bar all sedimentary matter brought out of the harbor by the outflowing currents, as well as accessive accretions of sand to the bar brought in by wave action.

Mr. Knapp also states that the force of the outflowing currents is in excess of the influence of the waves which tend to keep up sand in the bar, and he intends by the construction of the wall to cut down the waves to such extent that their action in moving sand from the deep water and depositing the same upon the bar will be so much diminished that the effect of the outflowing currents being relatively increased, a greater depth of water will be obtained and maintained.

His theory of the eroding action of the waves appears to be that it penetrates to the greatest depth, and that by it during great storms the bed of the sea has been excavated to its present depth and the *débris* deposited upon shoals, thus forming the boundaries and shores of the ocean, and upon this theory he supposes a constant transportation of sand, &c., from deep waters to the shoaler outlets of bays and rivers and a steady accumulation of materials from this cause upon bars.

In his paper, Appendix B, the author is not clear in his meaning, apparently making no distinction between waves of oscillation merely and those of translation, and thus rendering it difficult to follow or comprehend his ideas of wave action. The treatment of the subject generally has not had the effect of lightening the labors of the board by confining the discussion to particular points, and it is therefore necessary to take up the question in the most general sense, viz, whether the wall as proposed in this scheme of improvement would have the effect of deepening the water on the bar.

In the first place, the wall will collect on its NW. face the material borne from the bar by the outgoing currents, and upon the SE. face an accumulation will follow upon the action of the flood-tide and, during severe storms, from wave action. And the gentle slope upon the outside will be favorable to the passage of waves over the wall without breaking.

No oceanic currents were detected by the observation of the Coast Survey at a point ESE. from Sandy Hook and distant about 60 miles; but regular tidal currents nearly as strong as at the light-ship were found. In 1879 the Coast Survey observed on the line between Nantucket and Delaware Bay only a small tendency to a SW. current, scarcely ½ knot per hour.

The supposed littoral current off Sandy Hook, with power sufficient and in the proper direction to scour the foot of the wall clear of accumulations has not been verified.

That the waves exercise a potent influence both upon the volume and shape of the bar at Sandy Hook cannot be disputed, and it is equally certain that if the wave action could be eliminated the volume of the bar would be limited to the bulk of the material moved by the tidal currents and retained under the operation of their joint influence, and it would be spread to a greater length seaward. What the depth over the bar might finally be would be a matter of speculation; but a bar would still exist, due to the diminished scour of the currents expanding as they became released from the confinement of the land. Numerous bars and shoals exist in interior bodies of water not exposed to wave action, resulting solely from an undue expansion between banks.

The first matter to be investigated in discussing the present scheme of improvement is the extent to which wave action would be eliminated by the construction of the proposed wall, which is to be located about 3 miles outside of the bar and not far from midway between the coasts of New Jersey and Long Island; of which interval its length would embrace about one-third part, leaving two large spaces not closed by any structure: the one between the southwesterly end and the coast of New Jersey, the other between the northeasterly end and the coast of Long Island.

At the present time it is well known that *in these spaces*, where the water is shoaler than at the proposed location of the wall, a considerable action upon the bottom and shore lines exists both of waves and currents, by means of which large amounts of sand are transported from the outside and lodged upon the bar and upon interior areas, from which a portion is brought back by the ebb currents to the bar. The growth and changes of the peninsula at Sandy Hook, and the movements of the shore line of Long Island, furnish ocular evidence of these powerful sand-transporting agencies.

A glance at the topography of the bottom as delineated on the Coast Survey charts shows the exterior slope of the bar to be in a direction nearly north and parallel to the general line of Sandy Hook, until the beach of Coney Island is approached, when this direction is broken by a wide, long and deep indentation to the westward, extending so far as to leave but a narrow bulkhead to be surmounted before reaching the deep water of the interior bay. The topography proves the existence of two distinct eroding and transporting influences affecting the bar, one to the northward along the coast of New Jersey, the other westward along the coast of Long Island.

Another agency which would also be unaffected by the wall is the flood-tide eroding and transporting materials to the bar and interior waters, and also modifying the shape of the bar. In these effects it is much aided by the stirring up of the bottom, by the breaking waves and the currents due to waves of translation.

Having enumerated the influences at work in transporting sand from the outside to the bar and interior spaces which would not be diminished by the construction of the wall, there remains to be discussed only the modification or elimination of wave action upon the bottom over the area supposed to be controlled by the wall. Obviously the wall could effect that end only by breaking the waves.

The condition of leaving a sufficient depth of water between the surface and the top of the wall and at the same time of retaining a sufficient height of the wall to break up the seas are now to be discussed, and the compatibility of these requirements, upon which the practical application of the system depends, should be rigidly tested.

Great differences exist in the strength of the wind and its effect upon the force and height of the waves, as distinguished by the terms severe gales, storms, and great storms. While the former may occur one or more times during a single winter, storms are rare, and great storms may not visit a locality more often than once in twenty years.

In designing works of construction upon the sea-coast, the engineer, it is true, must endeavor to make them proof against the force of waves due to the severest storms, but, for the case now discussed, the great waves due to hurricanes and all storms of rare occurrence need not enter at all in the estimated effect upon the bar, since it is manifestly the influence of waves of frequent occurrence which would be potent in determining the depth and other features of the bar. Although it is proper to omit all consideration of unusually high waves as of rare occurrence, and therefore impressing no permanent features on the bar, it is nevertheless curious as a matter of fact that old pilots of thirty-five years' experience on the bar have not noticed even a transient decrease of draught produced by severe storms.

The question is therefore reduced to the effect of the proposed structure upon the more moderate classes of waves.

Measurements at this place of the heights of waves, ordinary or extraordinary, if ever accurately made, do not appear to have been recorded, and it is impossible, therefore, to be exact in drawing the line between waves of frequent and those of infrequent occurrence, but it is probable that an assumed height of about 16 feet would not be far from such dividing line. With few or no exceptions, waves of oscillation of 16 feet and less could pass over the top of the proposed wall without breaking or suffering serious modification. Waves of translation, as ground swells, which are the precursors or followers of gales, being of less height than the wind waves of the same storm, would pass over as well as those before mentioned. The tide wave would also pass, suffering but an imperceptible retardance in time.

The wall would have, therefore, little or no effect in arresting waves which affect the bar.

To sum up: The proposed wall will leave long intervals between its flanks and the adjoining shores, through which a vigorous wave-and-current action affecting the bar will be exercised. It will also permit the free influx of the flood-tide, over it and on either side, to operate upon the bar, and, finally, it will not arrest those classes of waves which are most instrumental in defining the depth and shape of the bar.

The supposition that the proposed wall will form behind it a harbor of refuge as secure as that behind the bar was framed upon the idea that the waves would be as much reduced by a wall 40 feet under water as by the much shoaler mass of the bar.

After a careful examination of this scheme, the Board are of the opinion that the proposed wall will not improve the navigation over the bar or form a secure harbor of refuge for any class of vessels.

Respectfully submitted.

Z. B. TOWER,
Colonel of Engineers, Bvt. Maj. Gen.
JOHN NEWTON,
Colonel of Engineers, Bvt. Maj. Gen.
HENRY L. ABBOT,
Lieutenant Colonel of Engineers, Bvt. Brig. Gen.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

LETTERS OF MR. HENRY F. KNAPP, CIVIL ENGINEER.

A.

NEW YORK, *August* 3, 1880.

GENERAL: I respectfully offer to the consideration of your Board the following argument and explanation of proposed improvement to the channel of New York Harbor referred to in bill H. R. No. 3042, Forty-sixth Congress, second session, and pray that the bill may be also taken as a part of this paper.

The bill is entitled "A bill to create a permanently deep, wide, and straight channel through the Sandy Hook Bar of the port of New York for the purpose of forming an improved commercial outlet," and is referred by the honorable Secretary of War to your Board for consideration as to its practicability.

The proposed work and improvement is based on the three forces or currents existing at the mouth of this port, viz, first, the force of the sea-waves acting on the sandy bottom outside the harbor to heave sand into the mouth and close it up by forming a bar across it; second, antagonistic to this current or force is the force of the outflowing currents which cut out the bar and channel, undoing the work of the first-named force, and alone prevents the force resulting from wave action from entirely closing up the mouth by building the bar up into an unbroken beach entirely across the mouth, and so creating a *terra firma* between the shores of New Jersey and Long Island; the third force is the littoral or shore currents, which sweep across the harbor outside of the bar at a rate varying from 1 to 2¼ knots per hour, and are most effective in carrying away from the outside of the bar all sedimentary matter brought out the harbor by the outflowing currents as well as excessive accretions of sand to the bar brought in by wave action. These three powers are all that exist at the mouth of this harbor, and all of them must be taken into consideration for any improvement of this entrance to New York Harbor.

The plan by which I propose to take advantage of these three currents and forces to permanently deepen, widen, and straighten the channel of this port is to build an artificial bar of stone located (as shown on the accompanying chart) outside the natural bar, and submerged so deep below the surface of low-tide that the heaviest draught ships may with perfect safety and ease pass over any part of it in coming in and going out of the harbor at any state of the tide or weather.

The effect of this artificial bar is to destroy or absorb a great part of the power of the sea-waves, thereby reducing their ability to build up the natural bar by carrying sand onto it, while at the same time the outflowing currents maintain their full original force to cut the bar down; in other words, there is immense power inherent in each of these two antagonistic forces, and by reducing the force of one the developed force of the other becomes increased. Such will be the effect and consequence of an artificial bar of stone located as shown to break down the force of wave action; but if the artificial bar was built of sand it would quickly be thrown in onto the natural bar, but being of heavy stone, built in a shape and manner designed to resist any force that can beat against it on this coast, it will become immovable. It will be observed that this plan for improving the channel of this port, based on these two opposing forces alone, would be permanently effective, but the third force, or shore currents, renders assurance doubly sure, inasmuch as it is a great auxiliary and will scour both in front of and behind the false bar, with all the effect it had originally on the bottom, and carry away all sedimentary deposits on the inside and sand accretions on the outside; this third force is the great scavenger of the outer harbor, while the outflowing currents perform that duty for the inner harbor. The natural sand bar may be said to be the battle-ground of the two first-named forces, and is situated so far inside, being simply an extension of the shore line, that the littoral current force has but little, if any, effect on it, consequently the beneficial effect of this great force is lost where it is much needed, and is only felt some miles outside the harbor, for which reason a great part of the sewerage and garbage of the port when dumped outside the natural bar is brought back by the force of wave action and stranded on the bar and contiguous shores both inside and outside the harbor; but extend the harbor as proposed by this false bar, which will reduce the present natural impediment to the velocity and concentration of the outflowing currents, all this refuse will be carried by natural laws into the great currents of the deep, even though it be dumped in the bay itself.

As observed, the first two named forces are continually at war to close up the mouth of the port or cut it out; between these two immense forces the surplus of power rests with the outflowing current, which, if unduly impeded by the encroachments of the bar on the capacity of the mouth or any sort of natural or artificial contraction, gathers up its force to an extra head level or backrise and breaks out; for this reason the force of wave action can never completely close up the mouth so long as there is outflowing drainage to escape. For the sake of illustration, this surplus force may be rated at about 10 per cent.; in other words, put the force of the sea-waves to close up the mouth at 100 and the outflowing current force at 110; this fact is recognized and acknowledged in the theory of jetties, by damming up and contracting the outlets of a harbor or river in order to get an increased head of water inside, and thereby raise and concentrate the force and power of the outflowing current to a greater surplus.

In contradistinction I propose to increase the difference between these two opposing forces by leaving the force of the outflowing current what it is, 110, but reduce the force of wave action to, say, 70 by means of the proposed false bar; from this it will be observed that the warfare continually existing between the forces of the outflowing current and wave action on the natural bar will be in great measure transferred to a constant warfare between the false bar and the force of wave action, leaving entirely unimpeded the force of the shore currents to act as they now act, with their full force, and by reducing its opposition to actually facilitate the outflowing current, causing it to flow with a greater velocity, and consequently cutting and eroding effect. It is a matter of general knowledge that the bay and harbor is rapidly becoming constricted and shoaled by the inexhaustible amount of street-washings and sewage constantly poured into it from the several cities of the port, and there is no method by which such evil can be so economically obviated as by facilitating an increased velocity of the outflowing currents. This point is one of great sanitary advantage also, as may be illustrated by the harbor hydraulics of many European cities, as well as Chicago, for one, in this country.

Another advantage of primary importance is that inside of this artificial bar will be as safe an anchorage and harbor of refuge as inside the present bar, a much needed necessity for all classes of vessels trading in or passing by the port; it will also offer a most valuable facility for vessels calling at the port for orders, without subjecting them to incur pilot charges therefor.

It may be remarked that the most scientific ship-architects and acute ship-owners have lately discovered that the economical increase in the capacity of steamers for speed lies in increased length first, increased depth secondly, and little, if any, increase of beam. When the time shall come for ship-owners to increase the capacity of their steamers proportionate to the increased depth of the bar of this port, as proposed by this improvement, the port of New York will eclipse the world in the exceeding great economy of its foreign transportation. Arguing by the falling market prices of the past dozen years, for American produce, otherwise the increased economy of production, this improvement is unquestionably a necessity to American producers, especially since it seems to be a foregone conclusion that grain hereafter, with ordinary crops, will rule 10 per cent. to 20 per cent. less in price than past average here in our Atlantic markets.

Some of this loss must be made up to the farmer in a reduction of transportation rates, otherwise the past rate of commercial progress in this country will be lessened.

For a more specific description of this artificial bar, it will be seen, by referring to the chart of 1875, that its upper end starts from the point at latitude 40° 29′ 25″ and longitude 73° 49′ 40″, showing 10 fathoms depth at low-water; from this point it takes a slightly curved direction, and extends to a point at latitude 40° 25′ 44″ and longitude 73° 53′ 48″, at which point is shown quite 16 fathoms at low-water, being a S. W. ¼ W. direction from the upper point, not including allowance for variation of compass, the curve being on a radius of 11 miles, and making the entire length of the structure 5 miles 950 yards, though it may be necessary to extend somewhat the southwest projection to secure the full depth and width of channel demanded by the bill, 31.6 by 500 feet mean high-tide.

The height of this artificial bar will be for the first $3\frac{9}{16}$ miles from the southwestern projection 25 feet high from the bottom of the sea, and the upper 2 miles will be 20 feet high. By a long study and careful analysis of the subject, the proposer of this improvement believes that the permanent improvement of the channel promised by this bill can be effected by an artificial bar of these dimensions. If it should require a greater capacity of structure it will be at his loss, and if he can effect the permanent improvement by a less capacity of structure it should equally be his gain. Before commencing the work, if Congress should see fit to award him the contract, a most thorough and elaborate survey of the entire ground will again be made, and any possible advantage that can be uncovered thereby will be embraced by the contractor to so modify his work as to reduce the cost of construction, the protection of the government and the harbor and the interests of the port being expressly guaranteed by lines 8 to 12, section 1, of said bill, which specify that "the said H. F. Knapp and his associates may construct such works on the seaward or outside slope of the bar," which simply means that they have no right to work inside the bar; "that such works shall not hinder, delay, or impede navigation." If they do, they may be stopped.

Section 5 says "that the said H. F. Knapp and associates are not to resort to the method of shutting off the flow of water through any of the several channels over the bar, either by damming them up in whole or in part by wing, sill, or spur dams or jetties," or in any way impeding or contracting the natural flow of water through them," "but that the design of the entire works is to make a permanently deep and self-sustaining channel-way." This simply means that the improvement is to be effected by working against the force of wave action, and in no other way. In short, the wording, as well as the tenor, of the entire bill show and mean that the results, as well as the works, are to be of a permanent character for all time, the work being done under the supervision of the War Department, who regularly are to report to Congress the progress made, and the work may be stopped and payments, if due, withheld, if the War Department shall consider that the terms of the bill are in any way transgressed or departed from during the execution of the work.

It is further designed by the bill that this improved channel shall locate itself between what are known as the "Swash Channel" and the "Fourteen-feet Channel," inclusive, and any improvement that will first accrue to the main ship-channel, which will also be greatly benefited whilst the channel lying between the above-named limits is making, entitle the contractor to no compensation whatever for such improvement. These works will enable the outflowing current to cut and permanently locate the proposed channel over the upper end of the "Fourteen-feet Channel" and the lower end of Romer Shoal, having a general northwest direction of the depth and width specified and necessarily giving far greater widths to shoaler depths, but the preliminary effect is intended to greatly improve "Swash Channel," which is included in the proposed limits, and carries its recompense.

It is well to remark that so long as the top of this artificial bar is not built above the level of the natural bar the outflowing currents will be accelerated, but if it should be built above it, a contraction of the mouth is effected, and the outflowing current becomes impeded, causing injury to the channel and a fill in the bay. Such elevation would also cause the current to flow past the ends of the false bar instead of directly over it. Sand cannot accumulate on top of it, as the entire force of the sea-waves would tend to tear the entire structure away, which cannot be, as it will be built of the heaviest stone. Neither is there any possibility that this bar can cause a shoal of sand, as its entire power is to largely destroy the force that alone heaves sand and sediment into the harbor, and at the same time protect the other two currents, which increase their velocity and action to cut out and away. On the contrary, the function of this bar is to enable shoals to be cut away.

The Raritan, Shrewsbury, Hackensack, Passaic, and Hudson rivers all discharge into New York Bay; therefore the mouth of New York Bay is really the mouth of all these rivers. Now, by opening the mouth of New York Harbor, as proposed by this plan, the outflowing currents in all these rivers will be quickened and concentrated, and therefore they will deepen and locate their channels to a large extent by their own energy, while any contraction of the mouth of the harbor would greatly deaden their outflowing currents and create fill in them.

Most respectfully,

HENRY F. KNAPP,
Civil Engineer.

General Z. B. TOWER,
Senior Member Board of Engineers.

B.

OCTOBER 21, 1880.

GENERAL: I respectfully offer to the consideration of your Board the following supplemental argument on the "mechanical action of wave motion," in further support of my proposition to deepen the bar at Sandy Hook, now under your consideration.

The amount of wave action of water depends on two conditions, winds and depth of water, both of which modify it from the one extreme of smooth water to the mountainous billows, and though we cannot control the winds from causing wave action, we can modify wave action itself by what may be scientifically termed "interference," a principle fully developed practically as well as experimentally, particularly in numberless experiments with the wave action of light, as frequently performed by scientists like Professor Tyndal, &c.

An explanation of the peculiar mechanism of wave action (as I understand it) may be sufficiently lucid to throw considerable light on my proposition now pending, and give a substantial indorsement to my plan for permanently cutting away the bar at the mouth of this port, by the forces of nature as they now exist, by simply modifying one of these forces by artificial means; in other words, it is proposed to *destroy* or reduce one of nature's forces for the permanent accomplishment of this object.

In order to treat the subject more comprehensively, let us go back to the beginning of the world, "when darkness covered the face of the earth," and allow to be assumed as a fact the most probable theory that all land was under and covered with a more uniform depth of water; that the action of the winds by causing undulation of the water caused the formation of shoals, &c. (to, however, slight extent primarily), which once formed kept continually increasing by continual deposits washed up by the undulations, until the great seas and oceans were dug out and the material therefrom laid on the various shores until great continents and islands were formed to be again modified by many outside causes.

(In the formation of dry land the winds act firstly in conjunction with the water in throwing it up on the shores, and subsequently entirely alone in taking it up from the shores and forming hills, dunes, &c., far above the water-mark.)

The peculiar action of the undulation of waters results in the translation or its tendency to translate solid matter along the bottom, and such translation is invariably from the deepest part of the water to the shoalest in all cases, and the quicker or more abruptly the water shoals the greater is this power of translation *per se* developed: this is true of the theory, but in practice it has its limit only by the angle of incline or rest of the beach, which if too great allows the material to return by its own weight, while the probability of its being moved forward at all is greatly reduced after the equilibrium is once established between the degree of incline and the power of the waves to build; in other words, the greater the power to build, the greater the resistance to build; this is unqualifiedly true, and if not always apparently carried out in nature, is because of littoral currents which undo the work done by translation.

This tendency or power to transmit material is due to the fact that the vertical motion, otherwise force or power, of the undulating waves is converted into horizontal motion and force in proportion as the water shoals, and in proportion to such shoaling is the friction of the water on the bottom necessarily increased, which results in the translation of sand, mud, pebbles, &c.

The result of this wave action is undoubtedly the sole and only cause of the formation of bars across the mouths of harbors, as well as the formation of beaches, &c.

(I believe that geologists credit the greater part of the State of New Jersey with having been thrown up by the sea-waves.)

No doubt bar formation is made up to a large extent by matter dropped directly on it from the river above; but if so, it ought to be attributed to the indirect consequences of wave action that produces a state of circumstances that results in an impediment to the rapid flow of the current; but it is far more probable that the greater part of the sediment held in suspension by the outflowing current is carried out far beyond the bar and washed back again by the waves, and for this reason the river is compelled to emit itself in a thin, shallow sheet over the bar.

WAVE ACTION.

Though the result of wave action is very decided and plain, its peculiar mechanism of action is quite a riddle.

It has frequently been stated that wave action involves no actual translation of water, but is merely the rise and fall, otherwise undulation, of water. It certainly seems impossible to conceive of the movement of water or anything else that does not involve translation. If water admitted of compressibility this theory might be passable, but as compressibility is not a property of water, it must be acknowledged that there is a translation of water in wave action by the fact that there is a movement of it from crest to hollow or wave to wave, which cannot occur without actual translation, and though such translation is not ordinarily apparent, it is a reality, nevertheless. It is the natural sequence of the water seeking an equipoise or balance of weight or column, and necessarily implies a change of particles, or translation from one column to another.

A book of statistics gives from the observations of a Mr. Douglas, "that when a wave has a height of

8 feet there are 35 to a mile and 8 per minute.
15 feet there are 5.6 to a mile and 5 per minute.
20 feet there are 3 to a mile and 4 per minute.
This 20-foot wave involves a velocity of 1¼ miles per minute."

On free tide waves the same book gives their seep as follows:

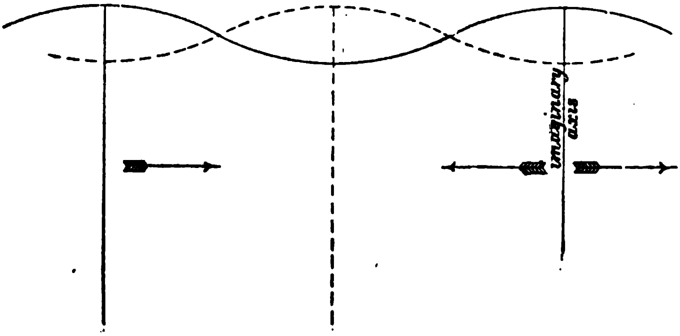
In 1 foot depth of water 5.7 feet per second.
In 10 feet depth of water 17.9 feet per second.
In 20 feet depth of water 25.4 feet per second.
In 40 feet depth of water 35.9 feet per second.
In 60 feet depth of water 43.9 feet per second.

From this it is apparent that a wave has motion, and, consequently, power or force, and the question is, What becomes of the force?

Take a sufficient section of a wave crest weighing, say, 1,000 tons, and, according to the above table, moving in 60 feet depth of water at the rate of 43.9 feet per second, which would represent a force of 44,319 foot-tons; now it is obvious, as the depth of water under this wave crest of 1,000 tons shoals ½, or from 60 feet down to 30 feet depth, that one half of this force disappears, and when the water shoals to 0 the other half disappears also, and consequently there is just so much original vertical but latterly horizontal force, 44,319 foot-tons, that has disappeared on a shoaling beach within a few seconds of space, and has to be accounted for, which can only be done on the hypothesis that the vertical force has changed into horizontal force, and is then rapidly dissipated and consumed by its friction on the bed of the sea or beach; if the bed be of yielding or unfixed material, like sand, mud, &c., it will be unable to withstand this amount of force or friction, and, in consequence, is rapidly heaved and moved up the beach or shore until the angle of incline of the beach is such that it is able to withstand this force, in which case the equilibrium of force and resistance becomes established.

Probably the reason the translation of the water is not more apparent is for the reason that such translation of the atoms themselves is excessively limited and small, because the height of the wave or amount of water constituting the crest bears so small a proportion to the depth of water, the translation of atoms being not entirely in the wave itself, but throughout the entire height of the vertical column of water under the wave or crest; and though the space through which these atoms move be limited, it is because the sum of the motions, to equal the motion of the crest or wave, is made up throughout the entire vertical column by giving sufficient aggregate of motion, or translation of atoms, to equal the contents of the wave; otherwise, a wave is the result of the atoms of water under it moving to a common center beneath it.

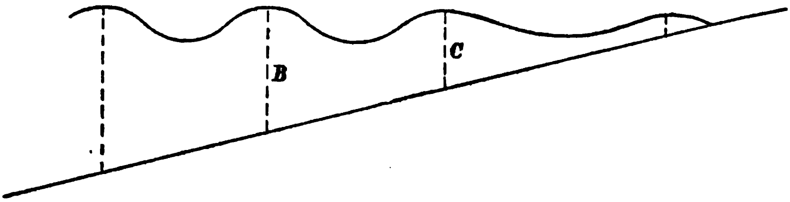
The translations of the atoms of water under waves cannot, of course, be continuously ahead with the directions of the running wave, otherwise the water of the ocean would be all piled up towards and on the shores, but on the contrary it is backwards and forwards; that is to say, the water of the vertical column immediately under the wave becomes flattened down by reason of the greater pressure than exists in the proximate vertical column under the hollow or depressed undulation, and, in consequence, sufficient of the forward half of the water under the wave column is pressed forward to assist in making up the wave to be formed ahead, while sufficient of the backward half is impelled backward to assist in making up the wave advancing in the rear; otherwise the column under the wave is divided by a vertical center or axis drawn perpendicularly from the crest, from which common center the water is pressed in two opposite directions; thus it is that the whole amount of translation to which the atoms of water are subjected by wave motion in a water of uniform depth is merely a continuously intermittent backward and forward movement of the atoms from column under crest to column under hollow, the hollow being next thrown up into a wave by the momentum the water has acquired by being pressed from the columns under the two contiguous crests toward the one common column under the intermediate hollow, as in figure here shown, and represents water of uniform depth.



(Say, on a depth of water of 100 feet, a wave has a height of 5 feet; on account of the triangular shape of the crest, probably but 2 per cent. to 3 per cent. of additional atoms to the wave column would equal the contents of the wave.)

Again, as the water shoals the height of the waves becomes less, and the amount of water to equal the wave, the force remaining the same, being yet unconsumed, must be taken up by *increased breadth* of the wave and the vertical column under the wave, and consequently must be transmitted to a greater horizontal distance and at a greater rate of horizontal speed or motion, which involves an increased friction on the bed bottom, and results in moving sand, pebbles, &c., up the incline, &c.

As an illustration of this case, the column B, having a greater vertical height and

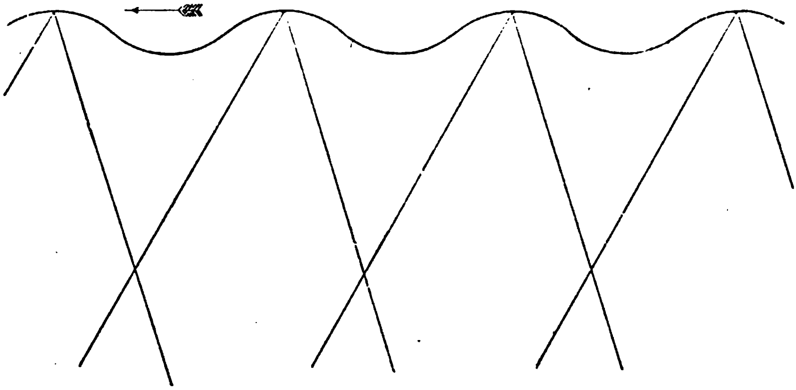


capacity, furnishes an equal and positive amount of matter to column C, having a less vertical height; and to receive this amount of water increased breadth of column of wave C must be proportionately enlarged, and this increased width must necessitate increased speed and consequently increased friction on the bottom, the propelling force being continuously used up by this friction, and the friction being always proportionate to the amount of inclination or shoaling of the beach or bottom.

In the retranslation of the water from the backward half of the wave having the less vertical height and greater breadth (as before explained, the water of the column under the wave dividing and going in opposite directions to make up the contiguous waves), the result of this action is just the reverse, and the friction on the bottom is below the mean, while in the half towards the shoaling it is above the mean, the half moving down the incline never cutting down the beach, but the half moving up the incline always building up the beach. One is positive and the other negative.

This is because the water passes from a smaller sectional capacity, C, into a larger sectional capacity, towards B, causing the water to continually decrease its speed as it enters the enlarging sectional capacity, just the same as the current of a river will decrease when entering the enlarged section of a river, and *vice versa;* consequently, the friction of the water on the bottom from the shoal towards deep water becomes proportionately reduced, thus losing its power to carry back the sand, and the result is the constant tendency of a beach to grow and encroach on the sea modified of course by shore currents.

To what extent waves affect deep bottoms must be largely a matter of conjecture; though the deepest bottoms have most probably been affected by the largest waves, all waves do not affect such bottoms, though in shoal water the weight of a wave is most directly supported by the column of water under it quite perpendicularly to the bottom. In deep water the weight of the wave would seem to be supported and dissipated over an extended base, the same as the cone of a mountain is supported and dissipated over an extended base, according to a well-known law of nature in such matters. This would go to show, then, that all waves do not affect very deep bottoms by their motion, and suggests that, except in rapidly shoaling positions, the greatest part of wave force is at the surface, gradually lessening towards the bottom.



In this accompanying illustration I have undertaken to show how the weight of waves is supported and dissipated by extending base lines towards the bottom, so that where the bottom is deep these lines actually cross one another, in which case, below their lines of intersection, the water must have a uniform pressure. The illustration shows the waves running to the left, and therefore the greatest resistance is towards the left, and the lines are therefore inclined to suit that resistance.

From this I therefore argue that the proposed artificial bar at New York, having an elevation of 25 feet in 65 to 70 feet of water, will destroy from 20 per cent. to 25 per cent. of the force of the sea-waves.

Again, the height or amplitude of waves, as well as their velocity, depends on the primary condition of depth, the velocity or force being proportionate to the square root of the depth, and as the depth decreases the height as well as the velocity decreases, resulting in a proportionate amount of force or motion being lost by friction in any position of decreased depth; that force is gone forever by the mere passage over the shoal or decreased depth.

In a discussion on a paper entitled "Origin of the Chesil Bank," before the Institution of Civil Engineers, London, in 1875, Mr. John Dunning stated that "he had recently seen a stone the size of his doubled fist which had been thrown by the force of the waves over the wall on to the esplanade at Sidmouth, a distance of 30 feet." In the same discussion Mr. Stevenson was quoted as having said in a paper on the German Ocean that "some drift stones of large dimensions, measuring upwards of 30 cubic feet, or more than 2 tons weight, have during storms been thrown upon the (Bell) Rock from deep water."

Mr. F. Wynne stated in this discussion that "a Spanish galleon was known to have gone down off Chesilton many years ago, and since then, after heavy storms, ingots of silver were sometimes washed up at Chesilton."

Again, "breakers" are caused by the resistance and friction the bottom part of a wave encounters in passing over the beach or a shoal, while the upper part of the wave, meeting with less resistance, maintains its velocity to a greater extent, and in consequence curls and breaks over.

Most respectfully,

HENRY F. KNAPP.

General Z. B. TOWER,
Senior member of the Board of Engineers.

APPENDIX E.

IMPROVEMENT OF RIVERS IN NORTHERN NEW JERSEY, AND OF STATEN ISLAND CHANNEL AT ELIZABETHPORT—IMPROVEMENT OF HARBORS ON LAKE CHAMPLAIN, AND OF OTTER CREEK, VERMONT, AND TICONDEROGA RIVER, NEW YORK.

REPORT OF LIEUTENANT-COLONEL N. MICHLER, CORPS OF ENGINEERS, BVT. BRIG. GEN., U. S. A., OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1881, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

UNITED STATES ENGINEER OFFICE,
New York, July 30, 1881.

SIR: I have the honor to transmit herewith the annual reports of operations on the several works of river and harbor improvements lately in charge of Lieut. Col. N. Michler, Corps of Engineers, for the fiscal year ending June 30, 1881, prepared under his direction.

Very respectfully, your obedient servant,

JOHN NEWTON,
Colonel of Engineers, Bvt. Maj. Gen., U. S. A.

The CHIEF OF ENGINEERS, *U. S. A.*

E 1.

IMPROVEMENT OF PASSAIC RIVER ABOVE NEWARK, NEW JERSEY.

The present project was adopted in 1872, and provides for the removal of rock and other obstructions between Newark and the head of navigation, so as to afford a sufficient channel 6 feet deep at mean low-water. The report of Col. John Newton to the Chief of Engineers, dated June 25, 1880, to which attention is respectfully invited, gives an outline of operations from the commencement of this work of improvement until June 1, 1880, when it was turned over to me.

By the river and harbor act of June 14, 1880, an appropriation of $2,000 was made for the continuation of this improvement. The boiler of the steam drilling scow, heretofore in use on the river in removing bowlders and other obstructions, having become unserviceable, but little work was done during the fiscal year. During the summer of 1880 an old stone pier or abutment, which greatly obstructed navigation, was removed from the draw of the bridge of the New York, Lake Erie, and Western Railroad, the railroad company having agreed to pay all expenses connected with the work. It being estimated that the cost of putting in a new boiler, and making such other repairs as were necessary to the scow and machinery, would be equal to or exceed the amount on hand for the improvement, it was not deemed advisable to undertake these repairs, but rather to build a new scow, should further appropriations be made for the improvement, or to continue the work by contract, or by hiring the necessary appliances and labor by the day.

Passaic River is in the collection district of Newark. Nearest light-house Passaic light. Fort Tompkins is the nearest fort.

Amount of revenue collected at Newark during the fiscal year ending June 30, 1881, $———. Amount of commerce to be benefited by this improvement, $2,000,000.

ORIGINAL ESTIMATES.

Middle bar, dredging	$936 00
Middle bar, diking	66, 375 00
Belleville bar, dredging	15, 501 00
Rutherford Park Bar, dredging	14, 112 00
Holman's and small bars above, dredging	12, 000 00
Contingencies	15, 000 00
Total	123, 924 00

AMOUNTS APPROPRIATED.

By act of Congress approved June 10, 1872	$25, 000 00
By act of Congress approved March 3, 1873	25, 000 00
By act of Congress approved June 23, 1874	20, 000 00
By act of Congress approved March 3, 1875	20, 000 00
By act of Congress approved August 14, 1876	10, 000 00
By act of Congress approved June 18, 1878	10, 000 00
By act of Congress approved March 3, 1879	2, 000 00
By act of Congress approved June 14, 1880	2, 000 00
Total amount appropriated	114, 000 00
Total amount expended	111, 547 38

Money statement.

July 1, 1880, amount available	$2, 901 22
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	448 60
July 1, 1881, amount available	2, 452 62
Amount (estimated) required for completion of existing project	9, 924 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	9, 924 00

E 2.

IMPROVEMENT OF PASSAIC RIVER, NEW JERSEY, FROM THE PENNSYLVANIA RAILROAD BRIDGE TO ITS MOUTH.

The existing project for this improvement was adopted in 1880, and provides for the formation and maintenance of a channel 200 feet in width, and 10 feet in depth at mean low-water, from Pennsylvania railroad bridge to Newark Bay. By the river and harbor act of June 14, 1880, an appropriation of $30,000 was made for this work. A project for the application of this amount was submitted July 12, 1880. This plan being approved by the Chief of Engineers, bids were invited by public

advertisement for the construction of about 2,000 linear feet of dike at the mouth of the river. These bids were opened on September 4, 1880. Messrs. Henry Du Bois & Sons being the lowest responsible bidders, the contract was awarded to them.

Work on the construction of the dike was commenced on November 26, 1880, and the section of dike under contract completed May 10, 1881.

The total length of the dike projected, of which the section built forms part, is 4,000 feet. As the line of the dike crosses the present channel, it was necessary to leave an opening in the dike for the passage of vessels, until the shoal separating the channel of Passaic River from that of the Hackensack could be dredged and the new channel would become available. It was not deemed advisable to commence the dredging before the completion of the section of dike under contract. As the full effect of this dike will not be developed until the opening in the same is entirely shut, it is believed that its effect would be to so far modify the tidal currents as to keep the dredged channel open until the gap in the dike is closed; accordingly, work on the excavation of the new channel was commenced on May 23, 1881, and is still in progress, under contract with Mr. Payn, of Albany. As a result of these operations, a channel 10 feet deep and 50 feet wide now exists, connecting the 8-feet curve of the river channel with the deep waters of Newark Bay; 19,263 cubic yards of material were removed.

The least depth in the old channel across the bar, which vessels heretofore were obliged to cross in entering and passing out of the river, is about 7 feet. It is proposed to apply the $50,000 appropriated by the river and harbor act of March 3, 1881, to extending the dike to its full development, and to closing the opening across the old channel, and to widening and extending the 10-feet channel by means of dredging as far up stream as the fund available will permit.

Passaic River is in the collection district of Newark, which is the nearest port of entry. Nearest light-house, Passaic light. Fort Tompkins is the nearest fort.

Amount of revenue collected during the fiscal year ending June 30, 1881, $———.

AMOUNT APPROPRIATED.

By act of Congress approved June 14, 1880	$30,000 00
By act of Congress approved March 3, 1881	50,000 00
Total amount appropriated	80,000 00
Total amount expended	24,343 13

Money statement.

July 1, 1880, amount available	$30,000 00	
Amount appropriated by act approved March 3, 1881	50,000 00	
		$80,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	21,665 57	
July 1, 1881, outstanding liabilities	2,677 56	
		24,343 13
July 1, 1881, amount available		55,656 87
Amount (estimated) required for completion of existing project		152,875 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		100,000 00

Abstract of proposals for the construction of pile dike at mouth of the Passaic River, New Jersey, opened September 4, 1880, by Lieut. Col. N. Michler, Corps of Engineers.

Number.	Names of bidders.	Linear feet.	Timber creosoted, per linear foot.	Amount.	Timber not creosoted, per linear foot.	Amount.	Remarks.
1	Albert J. Howell	2,000	$14 00	$28,000 00	$11 00	$22,000 00	
2	James D. Leary	2,000	13 44	26,880 00	8 94	17,880 00	
3	William H. Wood	2,000	13 25	26,500 00	9 50	19,000 00	
4	Henry Du Bois & Sons	2,000	9 25	18,500 00	6 50	13,000 00	Lowest bid.
5	Ephraim Varness	2,000	21 80	43,600 00	9 95	19,900 00	
6	Frank Pidgeon, jr.	2,000	11 78	23,560 00	7 88	15,760 00	
7	Ridgway & Young	2,000	13 00	26,000 00	9 25	18,500 00	
8	T. & A. Walsh	2,000	11 00	22,000 00	8 30	16,600 00	
9	John R. Brahans	500 1,500	12 09 13 43	26,190 00	7 72 9 06	17,450 00	

Contract awarded to Henry Du Bois & Sons, the lowest bidders, with the approval of the Chief of Engineers.

Abstract of proposals for dredging in Newark Bay at the mouth of Passaic River, New Jersey, opened May 9, 1881, by Lieut. Col. N. Michler, Corps of Engineers.

Number.	Names of bidders.	Price per cubic yard.	Remarks.
1	Edgar M. Payn	$0 13.9	Lowest bid.
2	Henry E. Du Bois	25	
3	John McDermott	21	

Contract awarded to Edgar M. Payn, the lowest bidder, with the approval of the Chief of Engineers.

Abstract of proposals for the construction of pile dike at the mouth of the Passaic River, New Jersey, opened June 23, 1881, by Lieut. Col. N. Michler, Corps of Engineers.

Number.	Names of bidders.	Quantity, linear foot.	Price per linear foot.	Amount.
1	John Brady	2,000	$18 00	$36,000 00
2	William H. Wood	2,000	14 37	28,740 00
3	John Kelly	1,625 375	15 00 16 00	30,375 00
4	Frank Pidgeon, jr.	2,000	14 10	28,200 00
5	Henry Du Bois & Sons	2,000	13 25	26,500 00

Contract awarded to Henry Du Bois & Sons, the lowest bidders, with the approval of the Chief of Engineers.

E 3.

IMPROVEMENT OF CHANNEL BETWEEN STATEN ISLAND AND NEW JERSEY.

The report of Col. John Newton to the Chief of Engineers, dated June 25, 1880, page 540 of Annual Report of Chief of Engineers, 1880, to which attention is respectfully invited, gives a history of this improvement from its inception until June 1, 1880, when the work was transferred to me.

By the river and harbor act of June 14, 1880, there was appropriated $29,000 for improving the channel between Staten Island and New Jersey, at Elizabethport. A project for the application of this appropriation, together with the balance remaining from previous ones, was submitted June 28, 1880. This project was referred to the Board of Engineers for Fortifications and River and Harbor Improvements. A copy of the report of this Board, which is appended for incorporation herewith, was received with letter of the Chief of Engineers on October 30, 1880, with directions to proceed with the work in accordance with the recommendations of the Board.

In pursuance of these instructions, bids were invited by public advertisement on November 9, for dredging the channel in accordance with the plan adopted. These bids were opened on November 30, 1880.

The Morris & Cumings Dredging Company being the lowest responsible bidders, the contract was awarded to them. Dredging operations under this contract were commenced on the 22d of December, and continued to the 29th of the same month, when, owing to the inclemency of the weather, and the large amount of drift ice, the contractors were compelled to withdraw their "plant" for the winter. Work was resumed on March 10, and is still in progress. Up to the close of the fiscal year 101,368 cubic yards of material had been removed, resulting in the formation of a channel 13 feet deep at mean low-water, and from 50 to 200 feet wide, extending from the deep water to the east of Shooter's Island to a point 700 yards to the west of the Corner Stake light.

The present plan of improvement provides for the formation of a channel of 400 feet in width, and 12 feet in depth at mean low-water; an additional depth of 1 foot, for a portion of the channel, is also provided for, so as to afford a depth of 13 feet over a width of 200 feet. The operations thus far have been confined to excavating the deeper portion of the cut, it being deemed advisable to execute this portion of the work first. The channel thus formed will at once be available for the larger class of vessels, and will afford a sufficient water-way for the passage of vessels during the period that dredging operations are in progress; the additional width of channel having a depth of 12 feet will also be secured.

The Board of Engineers recommend that, in case the dredged material be found to contain enough adhesive matter, it be deposited along the indicated lines of diking to form effective sections of an artificial bank. Thus far none of the material excavated was found of a suitable nature for this purpose, and it has consequently, all been deposited behind bulkheads at Pamrepo, N. J.

The estimated cost of the improvement, under the plan existing at the date of my last annual report, was $50,000. The project submitted June 28, 1880, for the application of the funds available was in accordance with this plan. As the amount on hand, $52,006.37, was in excess of the estimated cost of the improvement, no further appropriation was asked for.

The estimated cost of the improvement under the plan as subsequently modified by the Board of Engineers for Fortifications and River and Harbor Improvements is, for dredging, $125,705, and $60,000 for diking. The sum of $133,698.63 will, therefore, be required to complete the existing project; of this sum, $75,000 can be profitably expended during the fiscal year ending June 30, 1883.

This work is in the collection district of New York, which is the nearest port of entry; nearest light-house, Bergen Point light.

Amount of revenue collected at the port of New York during the fiscal year ending June 30, 1881, $139,579,562.83.

AMOUNTS APPROPRIATED.

By act of Congress approved August 14, 1876	$10,000 00
By act of Congress approved June 18, 1878	15,000 00
By act of Congress approved June 14, 1880	29,000 00
Total amount appropriated	54,000 00

Money statement.

July 1, 1880, amount available		$52,006 37
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$18,061 90	
July 1, 1881, outstanding liabilities	5,405 63	
		23,467 53
July 1, 1881, amount available		28,538 84
Amount (estimated) required for completion of existing project		133,698 63
Amount that can be profitably expended in fiscal year ending June 30, 1883		75,000 00

Abstract of proposals for dredging channel between Staten Island and New Jersey, opened November 30, 1880, by Lieut. Col. N. Michler, Corps of Engineers.

Number.	Names of bidders.	Price per cubic yard.	Date of commencement of work.	Date of completion of work.
1	Henry E. Du Bois	$0 35		
2	F. N. Brown & Elijah Brainard, jr.	35	January 1, 1881	October 1, 1881.
3	Joseph Cumings, president Morris & Cumings Dredging Company.	19½		

Contract awarded to lowest bidder, Morris & Cumings Dredging Company, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

OFFICE OF THE RECEIVER CENTRAL RAILROAD COMPANY, OF NEW JERSEY,
New York, June 15, 1881.

DEAR SIR: I send the following memoranda showing the commercial business transacted at Elizabethport during the year 1880 by the Central Railroad of New Jersey, and also the amount of business done by the commercial and manufacturing establishments at that place.

The Central Railroad of New Jersey received during the year 2,250,000 tons, and the Philadelphia and Reading Railroad 600,000 tons of coal. The miscellaneous freight received amounted to 70,000 tons, native ores 30,000 tons. The amount of pig-iron received was 42,000 tons, and cast-iron pipe 34,000 tons. Railroad and scrap-iron amounted to 3,500 tons.

The following are the principal manufacturing and commercial establishments and the number of men employed by each:

Singer Manufacturing Company, 2,500 operatives; four other factories, 50 operatives.

Four foundries, 600 operatives.

Repair shops, 50 operatives.

One ropewalk, 400 operatives.

Central Railroad of New Jersey, 550 operatives.

One car and wheel foundry, 20 operatives.

One rolling-mill, 50 operatives.

Total operatives, 4,220.

Elizabethport is, next to Jersey City, the chief commercial port in the eastern part of New Jersey. Access, however, to its wharves and docks is only possible for vessels drawing 12 feet of water or less, by reason of the shoals now existing easterly and westerly of Shooter's Island in Newark Bay; with these impediments removed a very great degree of commercial prosperity will result to Elizabethport and its vicinity.

Yours truly,

F. S. LATHROP,
Receiver and President Central Railroad of New Jersey.

General N. MICHLER,
United States Engineer.

LETTER OF THE CHIEF OF ENGINEERS.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., October 21, 1880.

SIR: I beg leave to submit herewith a project received from Lieut. Col. N. Michler, Corps of Engineers, for the application of the appropriation of $29,000 made by the river and harbor act of June 14, 1880, for the improvement of the channel between Staten Island and New Jersey, at Elizabethport, and of the unexpended balance of former appropriations applicable thereto; and also a report of September 25, 1880, from the Board of Engineers for Fortifications and River Harbor Improvements to which this project was referred.

In 1879 Colonel Newton, Corps of Engineers, the officer then in charge, suggested the dredging of the shoaler parts of this channel and protecting and preserving the part dredged by means of a short dike, the whole cost to be about $48,000. There is now about $52,000 applicable to the work, and Lieut Colonel Michler adopts, in his present project, Colonel Newton's plan.

The Board, however, is of opinion that considerable additions to the depth and width of the channel leading to Elizabethport have now become necessary for the commerce of that place, and recommend the dredging of the whole channel from Elizabethport to Newark Bay to a width of 400 feet and a depth of 12 feet at mean low-water, with an additional dredging of 1 foot deeper for a portion of the width, so as to afford a depth of 13 feet over a width of 200 feet; the cost of which is set down at about $125,000, and also suggests that beneficial results may be obtained, and the maintenance of the channel depths assisted, by short dikes located at certain designated points, and probably at other points to be determined by experience as the work progresses. If these future dikes should be of the form known as pile dikes the above estimate would be increased by about $60,000.

Believing with the Board that greater facilities to commerce are now required, and approving its views, I beg leave to recommend that the expenditure of the available funds be applied towards carrying out the plan of improvement proposed, and that Lieutenant-Colonel Michler be instructed accordingly.

Very respectfully, your obedient servant,

H. G. WRIGHT,
Chief of Engineers,
Brig. and Bvt. Maj. Gen.

Hon. ALEXANDER RAMSEY,
Secretary of War.

[First indorsement.]

Approved:
By order of the Secretary of War.

H. T. CROSBY,
Chief Clerk.

WAR DEPARTMENT,
October 25, 1880.

REPORT OF THE BOARD OF ENGINEERS.

OFFICE OF BOARD OF ENGINEERS FOR FORTIFICATIONS
AND FOR RIVER AND HARBOR IMPROVEMENTS, &C.,
New York, September 25, 1880.

GENERAL: The Board of Engineers to whom was submitted the project of General Michler for the application of the appropriation of $29,000, made at the last session of Congress, and of the unexpended balance from former appropriations, to the improvement of the channel between Staten Island and New Jersey, have the honor to submit the following report:

The plan of improvement as originally adopted (Report of the Chief of Engineers for 1873, pp. 943–945) was to extend the main channel at Elizabethport eastward, between parallel dikes, to join the channel of Newark Bay to the north of Shooter's Island, preserving at the same time that branch of the channel which runs northeasterly along the shore to the railroad bridge. And to prevent too great waste of the flood-currents (the useful agents here for scouring the bottom) through the latter channel which go to feed the upper part of the bay, it was further proposed to dam it off, in whole or in part, at the bridge, and to provide for the requisite amount of scour in this channel by inclosing a tidal basin between the north dike and the bridge. By these means it was intended that no more of the tide should flow through the northeast channel than was sufficient to preserve it, while the greater portion should be sent through the proposed channel running eastward. The south dike, at first intended to extend the whole length of the new channel, was afterwards designed to be terminated at a point considerably westward of Shooter's Island, thus leaving the old channel undisturbed and in condition for use by those preferring it. However, the beginning of the construction of the south dike, which has since been partially completed, was the signal for the display of great hostility to the project by the oystermen, who feared an interference with the oyster-beds, and by the towing interests of the Delaware and Raritan Canal, on the part of the latter because it was not clearly understood that the construction of the dikes need not interfere with the old channel south of Shooter's Island, which was preferred for the tows on account of certain presumed facilities of navigation on the flood-tide.

In consequence, a special Board of Engineers was summoned to examine and report a plan for the improvement of this channel. The result of their inquiry will be found in the report of the Chief of Engineers for 1876, part 1, pp. 252–256. They concurred with the local engineer as to the efficacy of his plan to produce and maintain a deep-water channel, which they believed to be correct in principle, and would be successful in practice. They, however, did not judge it expedient to recommend the completion of it on this ground:

> That whatever may have been the prospective requirements of commerce on this route three years ago, its present needs do not, in their opinion, call for a 14-foot channel at mean low-water, to be attained by the construction of dikes at a large cost.

They recommended the improvement of the channel by dredging a width of 500 feet to a depth of 11 feet at mean low-water, with the following estimate:

Dredging 230,000 cubic yards at 16 cents	$36,800
Contingencies 10 per cent	3,680
Total	40,480

They state also:

> Should the future needs of commerce demand a deeper channel than 11 feet, which we propose to obtain by dredging, it is our opinion that recourse must be had to the system of dikes proposed by General Newton.

At the present moment the rate for dredging would be higher, varying from 25 to 30 cents per cubic yard measured in place.

To carry out the project of the Board, there were appropriated as follows:

By the act approved August 14, 1876, $10,000.

As stated, the serious decline in the commerce of Elizabethport between the dates of the dike project and of the assembling of the special Board furnished a sufficient motive to stop the operations under that design. In 1877 the stagnation in business appeared to be even more serious, so that the officer temporarily in charge, receiving no reply to a communication addressed to citizens of the place as to the best mode of applying the available funds, amounting to a trifle over $10,000, decided to let the matter lie over, and await further developments.

By act of June 18, 1878, a further appropriation of $15,000 was granted.

In December, 1878, a communication was received from the Hon. F. S. Lathrop, Receiver of the Central Railroad of New Jersey, stating that the shipping capacity of Port Johnston was nearly employed, and that, in consequence, facilities at Elizabethport were in demand. He further stated that 18 feet of depth of channel and abundance of sea-room were necessary for an active business there.

The local engineer, in forwarding this communication to the Chief of Engineers, submitted a project for dredging and for the construction of a deflecting short dike to maintain the dredged channel near the corner stake, which could, if necessary, be afterwards extended to connect with deep water in Newark Bay.

In January, 1880, another communication was received from Mr. Lathrop, and forwarded, which stated, among other matters, that the Central Railway Company had expended over $100,000 in 1879 in the improvement of wharves, boat-docks, and slips, at Elizabethport, and that the Philadelphia and Reading Railway Company would expend a like amount upon adjoining docks.

In this communication Mr. Lathrop gives the delivery of coal at

Elizabethport in 1879 as 2,000,000 of tons, with a probable addition of 500,000 in 1880, and the delivery of 500,000 to 1,000,000 tons additional by the Philadelphia and Reading Railway. The amount of pig-iron received was 45,000 tons, and of cast-iron pipes 30,000 tons. There was also of miscellaneous freight 20,000 to 30,000 tons.

The local engineer recommended that operations be commenced upon the channel between Elizabethport and Shooter's Island, and that an additional appropriation of $29,000 be asked for.

Besides these communications from the Receiver of the Central Railway Company of New Jersey, the Board has caused further inquiries to be made at the same office, and have received additional information both by letter and personal interviews from the receiver, and are satisfied that considerable additions to the depth and width of the channel leading from Kill Von Kull to Arthur Kill have now become necessary for the commercial business of the port.

The Board accordingly recommends the dredging of the present channel to a width of 400 feet and a depth of 12 feet at mean low-water, with additional dredging of 1 foot deeper for a portion of the width, so as to afford a depth of 13 feet over a width of 200 feet. The lines of the 13-foot channel are laid down also, but intended only as an approximate, since observation alone ought to determine their final positions.

By this means a depth of 17¾ feet at mean high-water would be obtained, and a great relief afforded to the commerce of the port.

The currents here, which have been the principal agents in keeping open the existing channel, are those of the flood from Arthur Kill and Kill Von Kull. The former on entering the bay divide into two branches; the one following a direction nearly northeast, along the shore, and losing its force by dispersion before reaching the railroad bridge across the bay; the other flowing nearly east along the channel and near the corner stake light, trending and dispersing towards the northeast.

A portion of the flood from Kill Von Kull continues its western course through the channel south of Shooter's Island, and, rounding its southwest side, flows in a northwesterly direction towards the corner stake, and then disperses in a northeasterly direction.

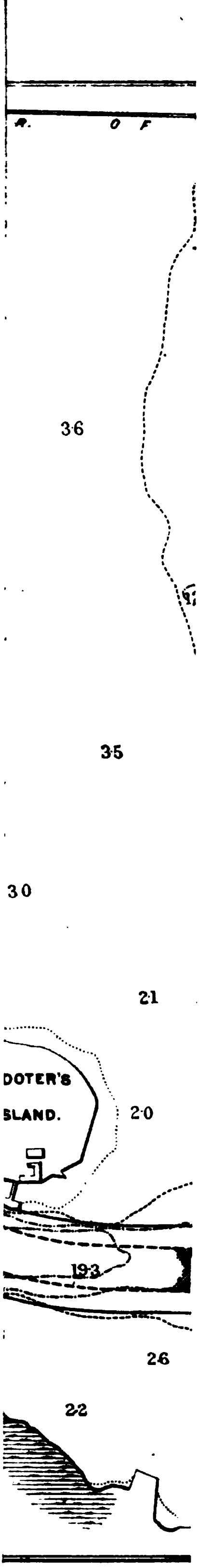
The two flood currents, one from the east and the other from the west, do not actually come into opposition, being at the corner stake nearly coincident in general direction. A salient point is therefore the result at the corner stake, which has been somewhat rounded off by the agitation incident to steam navigation.

Though it is evident that the depth in the channel may be increased by the action of dikes properly placed, as has been the case in front of a section of diking formerly constructed, yet it would not answer to confine the currents by continuous parallel walls throughout the whole extent of the channel, since the currents flowing in opposite directions would thereby be brought into direct conflict.

However, a beneficial result and the maintenance of the dredged depths may be assisted by partial lengths of dikes indicated at A, B, C, D, and probably at other points to be suggested by the lights of experience.

If the material dredged contain much adhesive matter, as is probably the case, it may be deposited along the indicated lines of diking to form effective sections of an artificial bank, which might be further protected from waves, currents, and ice by timber and pile structures where found to be necessary.

The system of partial diking would at least diminish the amounts of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future deposits, for it is not probable that the depths recommended in this report to be given to the channel could be maintained without some confinement of the currents.

ESTIMATE.

For a channel 400 feet wide and 12 feet deep at mean low-water: 232,900 cubic yards (in place) of dredging, at 35 cents	$81,515 00
For an additional depth of 1 foot for a width of 200 feet: 117,300 cubic yards (in place) of dredging, at 30 cents	35,190 00
	116,705 00
Contingencies	9,000 00
Total	125,705 00

The price of dredging is now very much advanced; and when the difficulty of disposing of this large amount is considered, it is possible that its deposit along A, B, C, D, and also behind the existing dike, may not increase the cost materially.

If the partial dikes should be of the form known as pile dikes, the estimate, in addition to that of dredging, would be about $60,000.

The complete dike system, as adopted in 1873, would be more effective in maintaining the depths in the channel, and would secure a greater depth than the project recommended; but, when it is considered that a greater depth than 14 feet would not avail because of the depth over the bar in Raritan Bay, the superior advantage in this respect of the first project becomes less marked. The estimated cost, also, of the full dike system would be about twice that of the system recommended.

It is likewise recommended that the amount available for this work be devoted to dredging in the channel, as laid down on the sketch accompanying this report.

The inclosed communication of Mr. P. H. Wyckoff, in reference to the vessels engaged in the commerce of Elizabethport, was handed to the Board by Mr. F. S. Lathrop, receiver of the Central Railroad of New Jersey.

Respectfully submitted.

Z. B. TOWER,
Colonel of Engineers and Bvt. Maj. Gen.
JOHN NEWTON,
Colonel of Engineers and Bvt. Maj. Gen.
HENRY L. ABBOT,
Lieutenant-Colonel of Engineers and Bvt. Brig. Gen.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

E 4.

IMPROVEMENT OF SHREWSBURY RIVER, NEW JERSEY.

A project for the thorough improvement of both branches of the river, resulting from a survey and examination made under the direction of Col. J. N. Macomb, was adopted in 1879. With the money appropriated prior to June 14, 1880, the two dikes at the junction of the north and south branches of the river were constructed; and a total of 7,067 cubic yards of sand dredged from the north branch. The dredging was confined principally to the new channel around Lower Rocky Point, where a direct channel about 70 feet in width and not less than 6 feet in depth at mean low-water was found. A cut about 30 feet wide, and 6 feet deep, was also excavated through the "cross over" at Upper Rocky Point to afford temporary relief to the vessels plying on the river as high up as Red Bank, until the direct channel past Barley Point can be opened. For reasons stated in the letter of the local engineer, dated August 23, 1880, a modification of the project previously adopted, as far as the same related to the portion of the river fronting along the town of Seabright above the bridge, was submitted to the Chief of Engineers for his consideration and approval. The modification proposed was adopted after being referred to the Board of Engineers for Fortifications and River and Harbor Improvements; a copy of the report of the Board, as also that of the letter of the local engineer on the subject, is appended for incorporation herewith.

By the river and harbor act of June 14, 1880, $30,000 were appropriated to continue the improvement. This amount, as far as expended during the fiscal year, was applied to constructing the dike in the South Branch at the entrance to Pleasure Bay in accordance with the modified plan, and to dredging a cut 90 feet wide, and 6 feet deep, through the flat at the entrance to the South Branch, and to dredging the direct channel at Barley Point, in the North Branch. In these operations a total of 24,017 cubic yards of sand was removed. Owing to the long and severe winter the contractor was unable to complete the dredging under contract by the close of the fiscal year, and an extension of time from July 1 to September 20, 1881, was granted.

The results thus far attained are most marked at the junction of the north and south branches of the river. By the scouring action of the currents the channel of the North Branch around Lower Rocky Point, which was originally dredged to a width of 70 feet, and 6 feet deep at low-water, has widened to about 100 feet in its narrowest part, and this channel is now exclusively used by the vessels going up and down the North Shrewsbury. A marked improvement has been effected at the entrance to the South Branch; the depth on the bar at this locality before improvement was about 3½ feet, and at present 6 feet at low-water can be carried from the deep water of the main branch up to above Bellvue; between this point and Seabright Bridge the least depth in the channel is 5 feet. As these improved channel ways are in a great measure due to the current action as moified by the construction of the training dikes, it is safe to conclude that the improvement will be permanent, and that the channels will, in all probability, deepen by the action of the natural agencies.

By the river and harbor act of March 3, 1881, an appropriation of $86,000 was made for the completion of this improvement, $36,000 of which, by the terms of the act, shall be expended in the improvement of the South Branch.

It is proposed to apply these amounts in accordance with the existing project, as follows: South Branch, the $36,000 to be applied to dredging channel 150 feet wide and 6 feet deep at low-water, from Seabright Bridge to entrance to Pleasure Bay; to constructing dike across "Polly's Gut," and widening the cut through the flat off Bellvue; also dredging at such other points of the channel above where the present depth is less than 6 feet at mean low-water. Main and North Branch: the $50,000 it is proposed to expend in constructing the dike below Island Beach; to dredging channel 150 feet in width and 6 feet in depth between Island Beach and the bar; also to dredging at such other points between Island Beach and Highlands drawbridge, where the present

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depth is less than 6 feet; and to dredging the channel of the North Branch in the vicinity of Lower Rocky Point and Barley Point; also between Barley Point and Oceanic Dock, so as to widen the 6-foot channel already formed and in course of construction. It is proposed to extend the operations as far as the funds will admit, and in accordance with the dimensions contemplated by the existing project.

It is believed by applying the appropriations as suggested that an uninterrupted channel of not less than 6 feet deep at low-water can be formed and maintained from the entrance to the river to Oceanic Dock, on the North Branch, and to Pleasure Bay on the South Branch; it will only remain to widen this channel at some points to the full width contemplated, in order to complete the improvement in accordance with the existing project. Owing to the difference between the estimated cost of dredging, viz, 25 cents per cubic yard, on which estimate the present appropriation is based, and the price, 34 cents, that is being paid at present; and also owing to the increased amount of material to be removed, which will become necessary by the modification of the project in the vicinity of Seabright, it is estimated that an additional appropriation of $47,000 will be required for dredging, in order to widen the channels to the full dimensions contemplated.

Shrewsbury River is in the collection district of Perth Amboy, N. J. Nearest port of entry, New York. The nearest light-house is Navesink light, and fort at Sandy Hook is the nearest fort.

Amount of revenue collected at Perth Amboy during the fiscal year ending June 30, 1881, $37,456.74.

AMOUNTS APPROPRIATED.

By act of Congress approved August 30, 1852	$1,500 00
By act of Congress approved March 3, 1871	14,000 00
By act of Congress approved March 3, 1873	5,000 00
By act of Congress approved June 18, 1878	18,000 00
By act of Congress approved March 3, 1879	10,000 00
By act of Congress approved June 14, 1880	30,000 00
By act of Congress approved March 3, 1881	86,000 00
Total amount appropriated	164,500 00
Total amount expended	67,086 23

Money statement.

July 1, 1880, amount available	$34,702 48	
Amount appropriated by act approved March 3, 1881	86,000 00	
		$120,702 48
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	15,073 11	
July 1, 1881, outstanding liabilities	8,215 60	
		23,288 71
July 1, 1881, amount available		97,413 77
Amount (estimated) required for completion of existing project		47,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		47,000 00

Abstract of proposals for dredging in Shrewsbury River, New Jersey, opened August 30, 1880, *by Lieut. Col. N. Michler, Corps of Engineers.*

Number.	Names of bidders.	Price per cubic yard.	Date of commencement.	Date of completion.
1	John McDermott	$0 95		
2	Frank Pidgeon, jr	49. 9	November 15, 1880	August 30, 1881.
3	William Flannery	40	Soon as ordered	Prosecute vigorously until completed.
4	Elijah Brainard	34	September 15, 1880	June 30, 1881.

Abstract of proposals for the construction of 1,500 *linear feet of pile dike in the South Branch of the Shrewsbury River, New Jersey, and opened October* 11, 1880, *by Lieut. Col. N. Michler, Corps of Engineers.*

Number.	Names of bidders.	First section and 250 linear feet of second section.			Second section and remaining portion of dike.			Aggregate
		Linear feet.	Price.	Amount.	Linear feet.	Price.	Amount.	
1	John Kelly	550	$5 25	$2, 887 50	950	$3 95	$3, 752 50	$6, 640 00
2	William H. Wood	550	7 10	3. 905 00	950	3 65	3, 467 50	7, 372 50
3	Henry Du Bois & Sons	550	6 50	3, 575 00	950	5 00	4. 750 00	8, 325 00
4	F. & A. Walsh	550	7 00	3, 850 00	950	4 00	3, 800 00	7, 650 00
5	Frank Pidgeon, jr	550	7 73	4, 251 50	950	3 99	3, 790 50	8, 042 00

Contract awarded John Kelly, the lowest bidder, with the approval of the Chief of Engineers.

Abstract of proposals for the construction of about 3,800 *linear feet of pile dike at the mouth of Shrewsbury River, New Jersey, opened June* 21, 1881, *by Lieut. Col. N. Michler, Corps of Engineers.*

Number.	Names of bidders.	Total length of dike, linear feet.	First section, linear feet.	Price per linear foot.	Amount.	Second section, linear feet.	Price per linear foot.	Amount.
1	John Brady	3, 800	1, 200	$9 50	$11, 400 00	1, 200	$10 50	$12, 600 00
2	William H. Wood	3, 800	1, 200	5 46	6, 552 00	1, 500	7 68	9, 216 00
3	Frank Pidgeon, jr	3, 800	1, 200	6 49	7, 788 00	1, 200	9 97	11, 964 00
4	H. Du Bois & Sons	3, 800	1, 200	6 00	7, 200 00	1, 200	8 50	10, 200 00
5	John Kelly	3, 800	1, 200	6 00	7, 200 00	1, 200	8 85	10, 620 00

Number.	Names of bidders.	Third section, linear feet.	Price per linear foot.	Amount.	Fourth section, linear feet.	Price per linear foot.	Amount.	Total.
1	John Brady	1, 300	$12 00	$15, 600 00	100	$15 00	$1, 500 00	$41, 100 00
2	William H. Wood	1, 300	8 19	10, 647 00	100	11 57	1, 157 00	27, 572 00
3	Frank Pidgeon, jr	1, 300	14 49	13, 637 00	100	14 22	1, 422 00	34, 811 00
4	H. Du Bois & Sons	1, 300	9 25	12, 025 00	100	12 00	1, 200 00	30, 625 00
5	John Kelly	1, 300	8 85	11. 505 00	100	8 85	885 00	30, 210 00

Contract awarded to lowest bidder, William H. Wood, with the approval of the Chief of Engineers.

Commercial statistics of exports and imports from May 1, 1880, *to May* 1, 1881.

EXPORTS.

Articles.	Quantity.	Value.
Straw ... tons.	200	$2,800
Hay ... do..	240	3,840
Fruits ...	...	300,000
Potatoes ... barrels	57,700	86,250
Garden truck ...	...	100,000
Clams ... barrels.	2,000	5,000
Oysters ... baskets.	50,000	115,000
Fish ...	...	100,000
Miscellaneous merchandise ...	...	25,000
Total value of exports ...	...	737,890

IMPORTS.

Articles.	Quantity.	Value.
Oysters ... bushels.	100,000	$20,000
Peaches ... baskets.	10,000	7,500
Hardware ...	...	100,000
Lumber ... feet.	5,000,000	150,000
Lime ... barrels.	2,000	2,000
Cement ... do..	2,000	2,500
Plaster ... do..	1,600	1,760
Shingles ... number.	400,000	6,000
Limestone and building stone ...	...	2,500
Guano ... tons.	150	85,500
Coal ... do..	43,752	131,434
Phosphates ...	...	3,000
Bricks ... number.	2,900,000	15,000
Agricultural lime ... bushels.	40,000	3,400
Gas lime ... do..	9,000	360
Shell lime ... do..	4,800	480
Manure ...	...	5,000
Sawdust ... barrels.	2,000	600
Laths ...	1,500,000	3,000
Glass ...	...	5,000
Paint ...	...	8,000
Ice ... tons.	1,100	5,500
Miscellaneous (merchandise and provisions) ...	...	500,000
Total value of imports ...	...	1,058,034

ARRIVAL AND DEPARTURE OF VESSELS.

Class.	No.	Tonnage.	Crews.
Steamers ...	575	520,311	10,088
Sailing vessels ...	426	218,261	1,704
	1,001	738,571	11,792

Fares received for passengers on steamers, $18,420.30.

PROJECT OF LIEUT. COL. N. MICHLER, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New York, August 23, 1880.

GENERAL: After a thorough personal examination of the channel ways of the South Shrewsbury River in the State of New Jersey, in connection with the results of the survey recently made during the latter part of May, and of which a map is being prepared, together with a careful consideration of the great commercial interest involved, I have the honor to submit for your consideration and approval a modification of the project already submitted by my predecessor in regard to that portion of the river fronting along the town of Seabright above the bridge, and opposite to a point on the west shore so frequently referred to in previous reports as "Jumping Point." The accompanying sketch will fully indicate the proposed change, the course of the new channel, and the lines of the proposed dikes being represented in blue, while the plan already approved is shown in red. The work on the latter has not as yet been commenced, and therefore no loss in labor or material will be sustained by the contemplated change. Many strong reasons can be urged in favor of the modified project, while a departure from the first adopted cannot in any conceivable way interfere with the interests of any party or parties; some of these may be briefly stated as follows:

First. On the east, or Seabright, side of the river the land and property have become very valuable, and are becoming yearly more so. The town itself as well as the magnificent villas, cottages, and adjoining parks, already constructed and in course of construction, and upon which large sums of money have been expended, will be greatly benefited by having the channel run along the line of docks or wharves which will in time extend out from the exterior line for solid filling as adopted by the riparian commissioners of the State.

On the opposite side of the river is a large extent of marshy ground, but one or two small houses occupying the highest points, and which during more than ordinary high-tides is covered with water.

Secondly. By the plan first proposed there is great danger that, after it is completed, the bed of the river between the dike H and the Seabright line of solid filling, will gradually shoal up and ultimately be converted into an extensive marsh. This is not a mere supposition, as facts have already demonstrated this probable result; the formation of the marshy ground marked A was commenced only four or five years ago by the dumping of some few loads of dredging material; the accidental throwing of some roots of grass upon the lump thus formed, and the growth of the same, gave consistency to it; since that time the spot has been constantly increasing, and, as shown by the sketch, a shoal is forming out towards the Seabright side. This shoaling would not only interfere with the approach to the town, but in a sanitary point of view would prove detrimental, as the outlets to the drainage and sewerage might become closed.

Thirdly. In the present condition of affairs the flood-tide flows up the west channel and the ebb seeks an outlet by the east one. By observations made at the bridge under the direction of Captain Ludlow, Corps of Engineers, it was ascertained that the average rise of tide is only 1.3 feet, and that the tidal wave ascends with a velocity less than 2½ miles per hour.

As a permanent improvement is absolutely necessary, it stands to reason that the first important step is to confine the river, as far as practicable, to one channel way; not only as its construction will prove more economical in the end, but it will be the means of confining the two tides in the same cut, and thus a greater benefit will be derived from their scouring process. As has already been shown, the one which will prove to be of most benefit is on the Seabright side; this, therefore, should be properly opened and the other closed.

Fourthly. The modified plan will not in the least interfere with the entrance into or navigation of Pleasure Bay, as by either plan there will be easy access or egress to and from its waters. Should either channel be deepened to the proper depth, 6 feet at mean low-water, there will be a less interrupted flow of water at high-tide, and consequently a corresponding rise in the bay.

Fifthly. It is stated by those acquainted with the navigation of these waters that sailing vessels in passing up the west channel find great difficulty in tacking past Jumping Point with winds blowing from certain quarters, but that the same difficulty does not arise in passing through the channel as proposed in the modified plan.

Sixthly. To render the improvement complete and permanent, a dike, marked L on the sketch, about 650 feet in length, should be constructed across the entrance to Polly's Gut, between Ledge Island and Jumping Point, to prevent the flow of any portion of the flood-tide through it. As there is but little water upon the bar, it will only be necessary to throw up a low dike of stone at small expense, which will fully answer the purpose.

Seventhly. The length of the east channel will not be greater than the other, the width and depth to be obtained in either case being the same. There will be, as indicated by the soundings, a greater amount of dredging in the former, but the length of the training-dike K will be about 350 feet less than the one marked H, as proposed in the first adopted. It is, moreover, confidently expected, upon the completion of the modified line of dike, that before any dredging is undertaken, and during that operation, the scouring action of the tides, the bottom of the river being entirely composed of sand, will very greatly reduce the amount of material to be removed. During the construction of the dike K, extending from Gunning Island to the Marsh Island A, it is intended to leave for the present a gap in the line where it crosses the west or Jumping Point channel; this can be closed upon the completion of the dredging in the east or Seabright one. It is not contemplated to close the water-way between Ledge Island and the opposite shore, that channel being left open for the purpose of drainage and sewerage. Even should the scouring process of the tides prove ineffectual, the estimated additional cost of the modified over that by the first plan proposed will not very much exceed $10,000; in consideration of the greater amount of benefit to be derived, this increase is but a trifling one. As can be seen from the sketch, the channel will make a more convenient entrance into or departure from Pleasure Bay; the citizens and visitors of both Long Branch and Seabright will be benefited by steamboat navigation between the two places. It is already in contemplation, as soon as the improvement of the South Shrewsbury is completed, to operate a swift line of steamers between these and adjacent points directly through to New York City.

Pleasure Bay is a beautiful body of water, and offers great inducements not only for excursion and fishing parties, but for very considerable commercial enterprise. There are several arms to this bay leading up to different localities, such as Branch Port, Ocean Port, and towards Monmouth Beach. One of the principal landings on the bay is very little over a mile from some of the principal hotels along Ocean avenue at Long Branch. The whole of Long Branch is deeply interested in the improvement of the South Shrewsbury. At present all horses and carriages from New York for this place have to go to Red Beach, on the Navesink, or North Shrewsbury, and then be driven some 7 miles; while if the channel at Seabright and near the junction of the two branches is deepened boats will be able to go directly to Ocean Port and Branch Port, and all freight, horses and carriages included, can be landed within 1 and 2 miles of Long Branch.

It may be finally stated that the course of the new channel can be best determined upon by a series of current observations, after the construction of the dike K. The material to be removed can be deposited behind the line of bulkheads which will probably be constructed by the property owners along the line of solid filling adopted by the riparian commissioners, or can be conveniently dumped behind the dike K, and by this means aid in closing up the old channel.

The present appropriation will only admit of the dredging out of the channel ways of the north and south branches opposite the dikes recently built and in the construction of the dike K of the modified plan.

Very respectfully, your obedient servant,

N. MICHLER,
Lieutenant-Colonel of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

[Indorsement.]

OFFICE OF BOARD OF ENGINEERS FOR FORTIFICATIONS
AND FOR RIVER AND HARBOR IMPROVEMENTS,
New York, *September* 16, 1880.

Respectfully returned with the following remarks:

The Board concur with General Michler in the proposed change of channel from the west to the east side of Island A in the south branch of Shrewsbury River, on the ground that the latter channel would best subserve existing business interests of the neighborhood, with the suggestion that a short dike extending from the north end of Sedge Island in a general northeast direction may be found necessary.

In behalf of the Board:

Z. B. TOWER,
Colonel of Engineers and Bvt. Maj. Gen.,
President of the Board.

E 5.

IMPROVEMENT OF RAHWAY RIVER, NEW JERSEY.

The improvement of this river was commenced in 1879, in pursuance of a project resulting from a survey and examination made under the direction of Col. J. N. Macomb, Corps of Engineers, United States Army, during the fall of 1878. This project provides for the formation of a channel 8 feet in depth at mean high-water, and varying from 100 to 125 in width; it is proposed to extend it from Bricktown up to Main street bridge, at the head of navigation. Dredging operations were commenced October, 1879, and continued until November 22, when work was suspended for the winter. During this period 2,773 cubic yards of material was removed, the excavation having been carried up stream 400 feet above the place of beginning. Owing to the failure of the contractor, Mr. E. G. Brown, of Elizabeth, to resume work after the suspension of operations in the fall of 1879, but little was done towards carrying out the plan of improvement during the fiscal year ending June 30, 1880. By the river and harbor act of June 14, 1880, an additional sum of $10,000 was appropriated for this work. Under this amount proposals were invited for continuing the dredging, but as the two bids received were considered informal by the department, they were both rejected and no award of contract was made. Subsequently the agreement of Mr. E. G. Brown was annulled, the time for the completion of his contract having expired; nothing had been done by the contractor towards resuming work. The unexpended balance of previous appropriation was added to that of June 14, 1880, and the work readvertised. The proposals received under this advertisement were opened on October 25, 1880. Mr. John Van Patten being the lowest responsible bidder, the contract was awarded to him. Owing to the lateness of the season work under this contract was not begun until April 16, 1881; from this date the work was vigorously prosecuted, and is still in progress, an extension of time for its completion being granted from July 1 to October 31, 1881.

This work is in the collection district of Perth Amboy, N. J., which is the nearest port of entry. The nearest light-house is Prince Bay light. Fort Tompkins is the nearest fort.

The amount of revenue collected at Perth Amboy during the fiscal year ending June 30, 1880, was $37,456.74.

AMOUNTS APPROPRIATED.

By act of Congress approved March 3, 1879	$10,000 00
By act of Congress approved June 14, 1880	10,000 00
By act of Congress approved March 3, 1881	10,000 00
Total amount appropriated	30,000 00
Total amount expended	10,502 46

Money Statement.

July 1, 1880, amount available	$17,891 74	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$27,891 74
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	5,532 44	
July 1, 1881, outstanding liabilities	2,861 76	
		8,394 20
July 1, 1881, amount available		19,497 54
Amount (estimated) required for completion of existing project		7,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		7,000 00

Abstract of proposals for the removal of sand, gravel, mud, and stone from the channel of Rahway River, New Jersey, opened October 25, 1880, by Lieut. Col. N. Michler, Corps of Engineers.

Number.	Names of bidders.	Quantity, cubic yards.	Price per cubic yard.	Amount.
1	John Van Patten	18,000	$0 85½	$15,390 00
2	John McDermott	18,000	1 24	22,320 00
3	William Flannery	18,000	97	17,460 00

Contract awarded to John Van Patten, lowest bidder, with the approval of the Chief of Engineers.

Commercial statistics.

Names of shippers, &c.	Articles.	Tons.	Value.
Colonel Russell	Poudrette, &c	6,000	$120,000
Harrington Dock		400	2,000
Auchincloss Dock		200	1,000
Charles Steel	Clay and coal	3,000	6,000
Hampton Cutter	Coal and lime	5,000	25,000
Brokaw & Co	Timber shipped	5,000	50,000
Public dock		5,000	50,000
James May	Timber shipped	5,000	50,000
H. E. Pierson	Coal, &c	2,000	10,000
Edgar Dock	Everything	3,000	15,000
E. F. Tappan	Coal, &c	3,000	15,000
Michael Friese	Coal, &c	3,000	15,000
Brewster & Co	Coal, lumber, &c	5,000	25,000
Samuel Ayers	Coal, &c	2,000	10,000
William Chamberlain	Coal, &c	8,000	35,000
Ayers & Suffiy	Lumber	3,000	20,000
Ayers & Suffiy	Rafters and timber	5,000	30,000
Rahway Gas Company	Coal	900	5,400
Tice's dock	Coal, &c	1,000	5,000
Almeth White	Ice	2,000	15,000
Hall's dock		1,000	5,000
Spear's dock		400	2,000
		68,900	521,400

Tonnage of merchandise would increase considerably if we had depth of water, which is now carried by railroad, owing to the difficulty of getting boats to come up the Rahway River. Have had two steamboats running between New York and Rahway, but had to suspend on account of the low depth of water. As soon as the river is deepened there will be a steamboat put on to run freight and passengers between New York and Rahway.

WM. CHAMBERLAIN.

E 6.

IMPROVEMENT OF ELIZABETH RIVER, NEW JERSEY.

The improvement of this river was commenced in 1879, an appropriation of $7,500 having been made by the river and harbor act of March 3, 1879, according to the recommendations contained in the report of Col. J. N. Macomb, Corps of Engineers, submitted December, 1878.

With this amount, dredging operations were carried on, under contract with E. G. Brown, of Elizabeth, N. J., up to September 6, 1880, when the funds became exhausted, and further operations were suspended. The river and harbor act of June 14, 1880, having appropriated an additional sum of $7,500 for the continuance of the work, a contract was entered into with Thomas H. Benton to continue the dredging in accordance with the existing plan, which provides for a channel 60 feet wide and 7 feet deep at mean high-water. Operations under this contract were commenced October 1, 1880, and continued until November 27, when work was suspended for the winter. It was resumed March 14, 1881, and continued to April 26, when the available funds became exhausted, and further operations were suspended. During the year a total of 9,200 cubic yards of material was excavated and placed on the adjacent river banks; the 7 feet depth has been carried up stream to a point about 150 feet below South Street Bridge.

Up to the present time 21,078 cubic yards have been removed; the total amount to be excavated in order to carry the 7-foot channel up stream to the first permanent bridge at Broad street, according to the original plan, is 44,400 cubic yards; this leaves 23,322 cubic yards to be still taken out. The cost of dredging was originally estimated at 50 cents per cubic yard, and the price paid under the first agreement was 37 cents per cubic yard.

Under this contract, however, the work was done at a heavy loss to the contractor. The lowest proposal received at the next letting of the work was $1.05 per cubic yard, which bid was approved and accepted. As the natural disadvantages under which the dredging must be prosecuted will increase as the cutting advances up stream, it is not probable that the work hereafter will be done at a less cost than the above ($1.05) per cubic yard. On this basis of cost for dredging, and adding 15 per cent. for contingencies and superintendence, there will be required to complete the improvement in accordance with the existing plan $28,160.

The river and harbor act approved March 3, 1881, appropriates $4,000 to continue the work. An additional sum of $24,160 will therefore be required to complete the improvement, and this amount can be profitably expended during the fiscal year ending June 30, 1883.

Elizabeth is in the collection district of Newark, N. J. Nearest light-house, Newark Bay, New Jersey, and the nearest fort is Fort Tompkins.

Amount of revenue collected during the fiscal year ending June 30, 1881, $——.

AMOUNTS APPROPRIATED.

By act of Congress approved March 3, 1879	$7,500 00
By act of Congress approved June 14, 1880	7,500 00
By act of Congress approved March 3, 1881	4,000 00
Total amount appropriated	19,000 00
Total amount expended	15,049 84

Money statement.

July 1, 1880, amount available	$9,455 69	
Amount appropriated by act approved March 3, 1881	4,000 00	
		$13,455 69
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		9,505 53
July 1, 1881, amount available		3,950 16
Amount (estimated) required for completion of existing project		24,160 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		24,160 00

Abstract of proposals for dredging in Elizabeth River, New Jersey, opened August 31, 1880, *by Lieut. Col. N. Michler, Corps of Engineers.*

Number.	Names of bidders.	Price per cubic yard.	Date of commencement.
1	John McDermott	$1 14	September 5, 1880.
2	William Flannery	1 09	
3	Thomas H. Benton	1 05	

Contract awarded Thomas H. Benton, the lowest bidder, with the approval of the Chief of Engineers.

Abstract of proposals for dredging in Elizabeth River, New Jersey, opened June 16, 1881, by Lieut. Col. N. Michler, Corps of Engineers.

Number.	Names of bidders.	Price per cubic yard.	Date of commencement.	Date of completion.
1	Elijah Brainard, jr	$1 15	April 1, 1882	June 30, 1883.
2	William Flannery	1 29	Not stated	Not stated.
3	Thomas H. Benton	1 05	......do	October 1, 1881.
4	John McDermott	1 25	......do	December 30, 1881.

Contract awarded to Thomas H. Benton, the lowest bidder, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

ELIZABETH, N. J., *May* 23, 1881.

DEAR SIR: Owing to the bankruptcy of the city two years ago, which caused a regular stagnation in nearly all branches of trade here, the tonnage on the river shows but a slight increase during that time. No large manufacturing interests have located on its banks recently and will use it extensively. Two large iron interests contemplate locating here and will utilize the river to a great extent. These, with a settlement of the city's financial troubles, will more than double the present amount of tonnage.

So far as the work of dredging has progressed it gives entire satisfaction and proves of great value to manufacturing and boating interests. When the work has progressed an eighth of a mile farther it will reach several large concerns (manufacturers and dealers in building material), who will use the river extensively in its improved condition.

As near as I can estimate from inquiry, &c., the tonnage for the past year exceeded 45,000. There is a gradual increase with a possibility of its reaching $100,000 this year.

Very respectfully,

H. F. J. DRAKE.

THOMAS FRANKLIN, Esq.,
Assistant Engineer.

E 7.

IMPROVEMENT OF WOODBRIDGE CREEK, NEW JERSEY.

The appropriation of $5,000 made by the river and harbor act of June 14, 1880, for the continuance of the improvement was applied to dredging a cut through the bar at the mouth of the creek. Operations under contract, dated September 28 with Elijah Brainard, jr., were commenced October 4, 1880, and continued to November 24, when the appropriation became exhausted and work suspended. Under this contract 7,022 cubic yards of material was removed, resulting in the formation of a cut through the bar at the mouth of the creek, connecting the 12-foot curve of Staten Island Sound with the 12-foot curve of the creek above the first bend. This cut is 12 feet deep at mean high-water, and 80 feet wide as far up stream as Boynton's Dock, above which point it gradually diminishes to a width of 20 feet.

The existing project for the improvement of this stream provides for a uniform depth of 12 feet at mean high-water in a channel 80 feet wide from the mouth of the creek as far up as the Salamander Dock. The estimated amount of material to be removed by dredging is 34,000 cubic yards. Up to the present time 12,554 cubic yards have been excavated, leaving 21,446 cubic yards yet to be removed. The cost of dredging was originally estimated at 30 cents per cubic yard. The price paid under the last agreement was 58¾ cents per cubic yard. As the dredging under the first contract at 20 cents per cubic yard was done at a heavy loss to the contractor, it is not probable that the work hereafter will be done for much less than the price paid under the last contract; on this basis of cost for dredging, there will be required $14,000 to complete the improvement in accordance with the existing plan.

Deducting the $5,000 appropriated by the river and harbor act of March 3, 1881, which it is proposed to apply to widening the cut through the bar to the full width contemplated, and continuing the 12-foot depth up stream as far as the funds will permit, an additional appropriation of $9,000 will be necessary to complete the improvement; this amount can be profitably expended during the fiscal year ending June 30, 1883.

Woodbridge Creek is in the collection district of Perth, Amboy, N. J. Nearest lighthouse, Prince's Bay, and nearest fort, fort at Sandy Hook.

Amount of revenue collected in the district during the fiscal year ending June 30, 1881, $37,456.74.

AMOUNTS APPROPRIATED.

By act of Congress approved March 3, 1879	$4,000 00
By act of Congress approved June 14, 1880	5,000 00
By act of Congress approved March 3, 1881	5,000 00
Total amount appropriated	14,000 00
Total amount expended	8,737 73

Money statement.

July 1, 1880, amount available	$5,176 99	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$10,176 99
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		4.914 72
July 1, 1881, amount available		5,262 27
Amount (estimated) required for completion of existing project		9,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		9,000 00

Abstract of proposals for dredging in Woodbridge Creek, New Jersey, opened September 2, 1880, by Lieut. Col. N. Michler, Corps of Engineers.

Number.	Names of bidders.	Price per cubic yard.	Date of commencement.	Date of completion.
1	Theo. R. Chapman	$0 72		Continue work until completion.
2	William Flannery	67	September 10, 1880	Prosecute the same vigorously until completion.
3	Frank Pidgeon, jr	68	When ordered	In fiscal year.
4	Elijah Brainard, jr	58¾	On or before September 30, 1880.	On or before November 20, 1880.

Contract awarded Elijah Brainard, jr., the lowest bidder, with the approval of the Chief of Engineers.

Abstract of proposals for the dredging in Woodbridge Creek, New Jersey, opened June 16, 1881, by Lieut. Col. N. Michler, Corps of Engineers.

Number.	Name of bidders.	Price per cubic yard.	Date of commencement.	Date of completion.
1	William Flannery	$0 77	Not given	Not given.
2	John Van Patten	65	September 1, 1881	June 30, 1882.

Contract awarded John Van Patten, the lowest bidder, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Statement of the tonnage of the shipments of clay and fire brick, and receipts of coal and merchandise through Woodbridge Creek, from May 1, 1880, to May 1, 1881.

Shippers and receivers.	Shipped.	Received.	Total.
	Tons.	*Tons.*	*Tons.*
Birkett & Patterson	3,342		3,342
H. N. Demarest		500	500
Watson Fire Brick Company	2,400		2,400
Hampton, Cutter & Son	7,413		7,413
William H. Cutter	3,048		3,048
C. F. Inslee	2,641		2,641
Samuel Dally	1,096		1,096
C. Patter	400		400
Warren Drummond	3,150		3,150
Salamander Works	4,832	2,950	7,782
E. J. Thompson	504		504
David Flood	2,000		2,000
C. W. Boynton	490	640	1,130
Charles Anness & Son	4,583	1,247	5,830
Augustin Flood	105		105
Henry Maurer	6,000	1,400	7,400
M. D. Valentine & Bro	3,000	3,500	6,500
F. W. Meeker	8,400		8,400
F. Rawland	1,000		1,000
William H. Berry & Co	1,616	2,279	3,895
P. B. Melick	7,000		7,000
John Powers & Co	5,152		5,152
Albert Martin	1,500		1,500
Daniel Ayres	400		400
Henry Koch	1,945		1,945
J. Mattison Melick	250		250
Total	72,267	12,516	84,783

E 8.

IMPROVEMENT OF MANASQUAN RIVER, NEW JERSEY.

A survey of the Manasquan River was made under the direction of Col. John N. Macomb, Corps of Engineers, in September, 1878, resulting in a plan of improvement submitted to the Chief of Engineers, through a report of January 27, 1879.

The river and harbor act of March 3, 1879, contained an appropriation of $12,000, "for improving Manasquan River, New Jersey." For the application of this amount, Colonel Macomb submitted a project, dated May 10, 1879; this plan was approved, and for the carrying out of which, a contract was entered into with C. F. Drake, April 18, 1879.

The contractor having failed to commence operations under his contract, it was annulled, and suit is now pending against him and the sureties on his bond. Further prosecution of the work was deferred until the project for improvement could be submitted to the Board of Engineers for Fortifications and for River and Harbor Improvements. The majority and minority reports of the Board were submitted to the Chief of Engineers on April 13, page 548–556, Annual Report of Chief of Engineers, 1880; the report of the majority of the Board being concurred in by the Chief of Engineers. Copies of these reports were transmitted by the latter, through letter of June 9, 1880, for my information and guidance, with the request that the subject receive my early attention, to enable me to report my views and recommendations in regard to the application of such funds to the work as might become available by the river and harbor bill, then pending in Congress, in addition to the balance of the former appropriation for the same object.

By the river and harbor act of June 14, 1880, an additional appropriation of $20,000, for continuing the improvement of the Manasquan River was made. A report was submitted to the Chief of Engineers, September 17, giving my views and recommendations in regard to the application of the funds available for the work of improvement. Instructions were received from the Chief of Engineers, November 17, directing that steps be taken for carrying on the improvement in accordance with the second of the two projects submitted by me, viz: the "opening a direct channel-way across the beach, and protecting the same from the flow of the tidal currents between the river and the ocean, so as to obtain and maintain a suitable depth for the passage of similar vessels to those now employed in the basins of the river, above its mouth, and for coasters of light draught." Also, that in preparing the details of the project and specifications, the views of the Chief of Engineers, as expressed during an interview had with him in regard to the subject, be as far as practicable carried out.

In accordance herewith, specifications were prepared, and a contract was entered into with Messrs. Henry Du Bois & Sons, for the construction of the timber jetties at the mouth of the river; the north jetty to be first constructed, the construction of the south jetty being optional with the officer in charge. Owing to lateness of the season, and the exceptionally severe winter, operations under this contract were not commenced until June 17, 1881.

Manasquan River is in the collection district of Perth Amboy, N. J., which is the nearest port of entry. Nearest light-house is Barnegat light, and nearest fort, fort at Sandy Hook.

Amount of revenue collected at Perth Amboy during the fiscal year ending June 30, 1881, $37,456.74.

COMMERCIAL STATISTICS.

Manasquan is at present measurably without commerce. Prior to 1870 from 12 to 15 vessels, principally schooners drawing from 4 to 6 feet, were owned in Manasquan, and plied regularly between this port and New York and Philadelphia. They entered the inlet on a rising tide, and are said to have experienced no difficulty, even when blowing a gale. The cargoes taken out consisted generally of wood and produce, and those brought in of coal and merchandise. At present, whenever the inlet is in such condition as to admit of navigating it, vessels enter with freights, but the uncertainty must, so long as it exists, operate as an effectual bar to the growth of any permanent trade. This, it is believed, would rapidly follow in the accomplishment of any successful improvement.

AMOUNTS APPROPRIATED.

By act of Congress approved March 3, 1879	$12,000 00
By act of Congress approved June 14, 1880	20,000 00
Total amount appropriated	32,000 00
Total amount expended	3,418 09

Money statement.

July 1, 1880, amount available	$30,658 45
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,076 54
July 1, 1881, amount available	28,581 91
Amount (estimated) required for completion of existing project	21,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	21,000 00

Abstract of proposals for the construction of a timber jetty at Manasquan Inlet, New Jersey, opened December 27, 1880, by Lieut. Col. N. Michler, Corps of Engineers.

Number.	Name of bidders.	Channel section, linear feet.	Price per linear foot.	Amount.	Inner wing adjoining channel section, linear feet.	Price per linear foot.	Amount.	Remainder of inner wing, linear feet.	Price per linear foot.	Amount.	Total.
1	H. Du Bois & Sons	200	$30 17	$6,034	400	$9 50	$3,800	1,100	$6 00	$6,600	$16,434
2	W. H. Wood	200	39 00	7,800	400	8 50	3,400	1,100	5 15	5,665	16,865

Contract awarded to the lowest bidder, Messrs. Henry Du Bois & Sons, with the approval of the Chief of Engineers.

PROJECT OF LIEUT. COL. N. MICHLER, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New York, September 17, 1880.

GENERAL: I have the honor to acknowledge the receipt of copy of the report of the Board of Engineers for Fortifications and for River and Harbor Improvements, dated April 6, 1880, upon the project submitted by Col. J. N. Macomb, Corps of Engineers, for the improvement of Manasquan River, New Jersey, and copy of the minority report on same subject, dated April 13, 1880, the report of the majority of the Board being concurred in by the Chief of Engineers. These papers were transmitted by the latter through letter of June 9, 1880, for my information and guidance with the request that the subject receive my early attention to enable me to report my views and recommendations in regard to the application of such funds to the work as might become available by the river and harbor bill then pending in Congress in addition to the balance of a former appropriation for the same object. My attention was also called to the previous history of the work as found printed in pages 463, 464, Report of the Chief of Engineers for 1879, and also a statement as to what steps had already been taken towards its execution.

For the application of the first appropriation of March 3, 1879, Colonel Macomb sumbitted a project dated May 10, 1879, which was approved, and a contract was entered into for carrying out the same. The contractor failing to conform to the same, the further prosecution of the work was deferred until the project for improvement could be submitted to the Board of Engineers. In connection with the report specially referred to me and with that of Capt. William Ludlow, of January 24, 1879, addressed to Colonel Macomb, there is the map of the Manasquan Inlet, a tracing of which is herewith inclosed, prepared from the recent survey of August, 1879. With all this information before me, and to enable me to become better acquainted with the locality, a personal examination or reconnaissance was made in company with my principal assistant engineer. From the several reports already rendered and the inclosed tracing a very accurate description can be obtained of the Manasquan Inlet, and it would therefore be superfluous to enter upon a repetition of the same.

The present inquiry will be confined to an expression of my "views and recommendations in regard to the application of the funds available" for this work of improvement. In the project for the prosecution of the latter two objects are sought to be obtained; one having in view the establishment of a harbor of refuge on the long reach of unbroken shore of New Jersey, between Sandy Hook and Barnegat Inlet, for the benefit of coasters of light draught; and the other in opening a direct channel-way across the beach, and protecting the same for the plow of the tidal currents between the river and the ocean, so as to obtain and maintain a suitable depth for the passage of similar vessels to those now employed on the basins of the river above its mouth, and for coasters of light draught. After the most careful consideration of the subject the conclusion has been reached that a harbor of refuge cannot be constructed at this locality without great expense, not at all proportionate to its utility or importance. As the Board observes, it would not prove of much public benefit.

A harbor of refuge is probably needed along this coast, but it should be sufficiently deep and spacious to admit the larger class of coasting vessels. Such harbor could be constructed only upon "the plan modified considerably from the one presented, and at much greater cost." Any project for its construction will have to include the extension of the piers out beyond the line of heavy surf, and the entrance to the channel between them covered by a breakwater of sufficient length to diminish the force of the heaviest of the ocean waves. The iron pier at Long Branch extends out about 800 feet to beyond the line of surf, and still steamers do not land at its end on account of the heavy swell, but tie up along the side to the windward; they never attempt to reach the pier unless able to cross the bar safely at Sandy Hook. Some of the wooden piles, which act as fenders to the iron ones, show some very rough usage from the effects of storms. It is very doubtful whether even small vessels of 4 or 5 feet draught would venture during rough weather to enter between the piers as projected in the proposed plan of improvement; the heavy seas would have a tendency to make them touch bottom in a channel-way of 6 or 7 feet in depth. As both Sandy Hook and Barnegat are each within 25 miles of the locality, it is more than likely that an experienced sailor would make for either of these harbors in preference to attempting a passage through such a long narrow outer entrance into the inner harbor.

For these and other reasons, to say nothing of the the insufficiency of the appropriation, the idea of constructing a harbor of refuge at this inlet cannot reasonably be entertained.

As to the second proposition, the opening of a direct channel-way, across the beach for the flow of the tidal currents between the ocean and the lower basin of the river for the accommodation of such small craft as can be employed in faciliating the trade of the valley of the Manasquan, the following observations are submitted. As stated in the report of the Board of Engineers, the object of the proposed work is simply to restrain the wanderings of the inlet and to direct the flow of the tidal currents through the outlet in a constant channel across the beach.

To effect this object my views are in accordance with those of the Board, that there can be no durable or permanent improvement unless the piers be extended out sufficiently far by artificial works so that the mouth or entrance to the inlet be established at such a depth as to prevent by the resultant forces of the waves and currents the formation of a similar bar as that which now exists. To accomplish this the piers must necessarily be prolonged to a much greater length than those adopted in the project submitted for this improvement. As the funds at present available are not sufficient to construct this desired extension, and to furnish the necessary strength and stability to the work, the question arises as to the most advantageous application to be made of the same so as to secure the greater amount of benefit to the commercial interests of the locality immediately interested.

It may be necessary to state that since this subject was first discussed the facilities of communication and transportation to and from the valley have been very much increased within the last few months; in fact all difficulties removed by the extension of the Long Branch Division of the Jersey Central Railroad, to and across the Manasquan River, as far as Point Pleasant. The road crosses the river over a pile bridge, about 1 mile above its mouth. The construction of this road obviates to a great degree the necessity for the proposed improvement, as now the lack of communication is supplied.

Should it be decided, however, to attempt some plan of improvement, and to prosecute it towards completion, the general lines of dike as proposed by Colonel Macomb, and as described in his report and in that of the Board of Engineers, might be successfully adopted; many of the actual details of construction may require alteration, and the plan modified as the work progresses. There will be no great difficulty in constructing the two lines of dikes across the interior basin, or of the revetments across the beach. As recommended, the north dike should be first built, the work across the beach being carried on simultaneously. As there is no material at hand for the construction of mattresses the pile structure will have to be adopted; in other respects the suggestions of the Board of Engineers should receive every consideration. The exterior lines of piers beyond the beach will be of an experimental nature; the effects of storms upon them will prove their stability, and the movable, drifting nature of the sands will in one way or another decide the problem as to the formation of a new bar across the artificial entrance to the inlet.

Owing to the absence and untried character of any similar work along the Atlantic coast, none so exposed to the fierce elements of that ocean, a safe estimate cannot be made as to the probable final cost. One single storm may demolish the whole structure, as it is now a well-established fact that a single gale changes the entire nature and position of the inlet under discussion; in fact it is claimed that owing to the instability of the sandy shores, every change of tide affects the entrance to a more or less degree. The question will arise as to whether the enormous expense of constructing and maintaining such a work will prove commensurate to any beneficial result that may be gained. There are some speculative minds who see in this improvement the saving of millions of property from destruction by storms, but the experience of the past will scarcely justify such an assertion.

Should the Chief of Engineers approve and authorize the construction of this work of improvement according to the project of Colonel Macomb, and as modified by the recommendation of the Board of Engineers, authority is respectfully requested to have the work done by contract, and that proposals for its execution be invited by the usual mode of advertising.

Very respectfully, your obedient servant,

N. MICHLER,
Lieutenant-Colonel of Engineers.

The CHIEF OF ENGINEERS, *U. S. A.*

E 9.

IMPROVEMENT OF RARITAN BAY, NEW JERSEY.

The survey for this improvement was directed by the river and harbor act of June 14, 1880, and on December 29, 1880, the results of this survey, together with a project and estimate, were submitted to the Chief of Engineers.

By the river and harbor act of March 3, 1881, an appropriation of $50,000 was made, and this amount will be applied to dredging a channel across the shoal off Seguine Point. It is estimated that the available funds will be sufficient to excavate a channel about 120 feet wide and 21 feet deep at mean low-water through the shoal, leaving it to future appropriations to widen this channel to the full width of 300 feet as contemplated.

The amount asked for the year ending June 30, 1883, will be applied to continue the existing project.

This work is in the collection district of Perth Amboy; nearest port of entry, Perth Amboy; nearest light-house, Prince's Bay, and nearest fort, fort at Sandy Hook.

Amount of revenue collected in the district during the fiscal year ending June 30, 1881, $37,456.74.

AMOUNT APPROPRIATED.

By act of Congress approved March 3, 1881	$50,000 00
Total amount expended	315 68

Money statement.

Amount appropriated by act approved March 3, 1881	$50,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	315 68
July 1, 1881, amount available	49,684 32
Amount (estimated) required for completion of existing project	76,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	76,500 00

Abstract of proposals for dredging in Raritan Bay, New Jersey, off Seguine Point, opened June 17, 1881, by Lieut. Col. N. Michler, Corps of Engineers.

Number.	Names of bidders.	Quantity, cubic yards.	Price per cubic yard.
1	John McDermott	460,000	$1 00
2	Atlantic Dredging Company, by R. G. Parkard, president	460,000	28
3	Joseph Cumings, president Morris & Cumings Dredging Company	460,000	30

Contract awarded Atlantic Dredging Company, the lowest bidder, with the approval of the Chief of Engineers.

Vessels entered and cleared at the port of Perth Amboy, N. J., from June 30, 1877, to June 30, 1881.

VESSELS ENTERED.

Year.	Coastwise.		American vessels.		Foreign vessels.		Total.	
	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.
1877	69	13,955	2	243	2	509	73	14,707
1878	137	31,296	8	716	9	1,557	172	35,569
1879	199	43,765	4	1,567	9	4,474	212	49,806
1880	134	26,693	17	4,677	15	5,725	166	37,095
1881	72	15,211	4	2,199	14	17,125	90	34,535

VESSELS CLEARED.

Year.	Coastwise.		American vessels.		Foreign vessels.		Total.	
	Number.	Tons.	Number.	Tons.	Number.	Tons.	Number.	Tons.
1877	31	6,704	6	1,511	14	2,911	51	11,126
1878	57	9,170	82	11,262	37	5,944	176	26,376
1879	90	13,547	40	15,286	25	8,713	155	37,546
1880	53	16,504	9	2,880	22	3,938	84	23,322
1881	58	28,136	19	7,746	27	7,927	104	43,809

Value of exports and imports, and duties collected and accrued at port of Perth Amboy, N. J.

Year.	Exports.	Imports for consumption.	Imports for warehouse.	Total.	Duties collected.	Duties accrued.	Total.
1877	$64,318 16	$2,533 00	....	$3,533 00	$46 20	....	$46 20
1878	134,081 00	4,503 00	....	4,503 00	247 60	....	247 60
1879	134,657 00	17,980 00	....	17,980 00	2,851 40	....	2,851 40
1880	31,158 00	61,076 77	....	61,076 77	15,466 25	....	15,466 25
1881	84,126 00	111,298 00	81,109 00	192,408 00	37,456 74	$14,732 25	82,188 99

Statement of number and tonnage of vessels belonging to and documented at port of Perth Amboy, N. J.

Years.	Sailing vessels.		Steam vessels.		Barges.		Canal boats.		Total.	
	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.	Number.	Tonnage.
1877	302	17,060.45	42	8,339.32	48	7,490.64	80	8,552.56	472	41,446.97
1878	302	13,998.38	51	8,744.59	51	7,838.52	85	8,912.13	489	39,493.62
1879	311	16,001.66	57	9,356.20	55	8,278.76	137	14,848.05	560	48,484.67
1880	318	16,848.87	62	10,211.87	61	10,660.87	137	14,784.30	578	52,505.91
1881	326	18,684.31	69	11,208.06	73	14,947.28	138	14,940.08	606	59,779.73

SURVEY FROM PERTH AND SOUTH AMBOY TO MAIN SHIP CHANNEL OFF GREAT KILLS, RARITAN BAY.

UNITED STATES ENGINEER OFFICE,
New York, December 29, 1880.

GENERAL: Section 2 of the river and harbor act, approved June 14, 1880, provides "that the Secretary of War be directed, at his discretion, to cause examinations or surveys, or both, and estimates of cost of improvement proper to be made" at certain points.

Of those named in the act the following, among others, was assigned by your direction to my charge: "Perth and South Amboy to main ship channel off Great Kills, Raritan Bay."

In this case it was decided to make a detailed survey, in order to determine upon the nature of the proposed improvement to the channel, so as to render it navigable for the largest class of sea-going vessels. The accompanying report of the survey in detail, prepared by my principal assistant engineer, is respectfully submitted; it is accompanied by a map of the same, together with a project for and an estimate of the cost of the necessary improvement.

The appended letters from and summary statements furnished by the collector of the port of Perth Amboy embrace such information concerning the commercial importance, present and prospective, of the improvement contemplated thereby, and such general commercial statistics as could be procured at the time.

The project for deepening the channel appears, after a careful personal inspection of the locality, to be the only one applicable, and one which can be practically and successfully executed.

The greatly increased demands of commerce will justify, as is believed by those who have studied the great commercial interests of the country, the expenditure of the amount required for its execution. The grand chain of railroads already in operation or in course of construction or farther extension will render the approach to the safe and beautiful harbor of Perth Amboy by the largest of sea-going vessels an absolute necessity. The estimated cost of making the partial improvement as proposed at this time is $126,500. The price per cubic yard for dredging is deemed reasonable, and is based upon that paid at other localities, and in consideration of the probable decrease in the number of working days, owing to the exposure to severe weather in an open and exposed sheet of water as extensive as the Raritan Bay. The latter is certainly one of the most beautiful inland bays on the coast, and offers at all times a safe anchorage and harbor of refuge for outward or inward bound seafaring vessels or sea-coasters during the prevalence of severe storms. The table on the map affords information in regard to the currents and tides.

* * * * * * *

Very respectfully, your obedient servant,

N. MICHLER,
Lieutenant-Colonel of Engineers.

The CHIEF OF ENGINEERS, *U. S. A.*

REPORT OF MR. A. DOERFLINGER, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
New York, December 27, 1880.

SIR: I have respectfully to submit the following report on the survey from Perth and South Amboy to main ship-channel off Great Kills, Raritan Bay. The field work was executed between August 27 and October 16; it embraced the development of about 24 square miles of hydrography, and the survey of about 22 miles of shore line.

* * * * * *

The plane of mean high and low water at South Amboy being already established by observations previously made under the direction of Col. John Newton, Corps of Engineers, no continuous tidal observations were necessary; gauges were, however, set up at Perth Amboy, Seguine Point, entrance to Cheesequake Creek, and Keyport, and observed simultaneously with the established gauge at South Amboy at different periods of one lunation.

From these observations it appears that the tidal rise and fall, as also the tidal intervals at the different points mentioned, are practically the same, except during the prevalence of high winds from certain quarters, when small differences in the tidal range and tidal intervals occur. In order to determine the velocity and direction of the tidal drift, current observations were made in the vicinity of Great Beds light and off Seguine Point, during the maximum velocity of ebb and flood currents. For this purpose free spar-floats, extending from the surface to below mid-depth, were used, the position of the float being determined at intervals of one minute by means of transit observations from two stations on shore. From these observations it appears that at both localities the ebb and flood currents run in nearly opposite directions, the ebb attaining its minimum about $2^h\ 20^m$ after the preceding high-water, and the flood its maximum about $2^h\ 25^m$ after the preceding low-water; the change from ebb to flood and from flood to ebb current happening at about the time of low and high water stand respectively.

An inspection of the map shows that the deep water of the main ship-channel extends to within about 2 miles of Seguine Point, whence the depth gradually decreases from 24 feet to 14¼ feet. From Seguine Point to the docks of Perth Amboy there is again a good channel, with a least depth of 21 feet at mean low-water. As shown by the borings made to a depth of 28 feet below low-water, the shoal separating these two channels consists entirely of soft mud, and its existence seems to be due mainly to the action of the tidal currents. The current observations show that as the ebb current leaves Seguine Point a gradual diminution of velocity takes place. The carrying capacity and force of the current being thus reduced, the material held in suspension is deposited, the shoal being the result of this action. Any plan of improvement looking to a permanent deepening of the channel across this shoal will therefore necessarily involve the construction of works having for their aim a modification of the tidal currents.

Dredging a channel across the shoal alone will in all probability not effect a permanent improvement, and the same operation may have to be renewed from time to time in order to maintain a sufficient depth. As almost the entire bay is, however, taken up with oyster-beds, the inhabitants of the adjacent shores being largely engaged in oyster-culture, the execution of any work, such as the construction of a jetty across the shoal, will likely meet with opposition from this interest. Owing to the forcible action of the waves, to which the work would necessarily be exposed, and the difficulty of obtaining a solid foundation, the construction would also be of a very expensive character. The system of construction best suited to the local conditions seems to be a jetty of rubble-stone of suitable size, thrown in *à pierre perdue*, and built up above high-water. As the settlement of stone in the soft mud bottom will likely be very great, and cannot be definitely determined beforehand, an approximate estimate only of cost can be given, which would be probably not less than $60 per linear foot. To be effective the jetty would have to be carried out from Seguine Point at least as far as the 18-foot curve of the main ship-channel, a distance of 7,500 feet; the probable cost would therefore be about $450,000. In addition to the great cost of such a work, another objection to its execution presents itself; this arises from the fact that while facilitating the passage of deep-draught vessels from the main ship-channel to Perth Amboy, the structure would form a serious obstruction to the numerous light-draught vessels plying between New York Harbor and Perth Amboy, and other points on the Raritan River, since they would then have to round its outer extremity, and be compelled to keep farther off from the Staten Island shore, under the lee of which they now pass during the prevalence of high north and westerly winds. From the foregoing considerations it seems that all the interests concerned would be best conserved by forming a channel across the shoal entirely by means of dredging. As this would form part of the project, even should the jetty be constructed, it appears advisable to resort to this remedy first; should it be subsequently found necessary to construct the jetty in order to maintain the depth in the dredged channel, and should the commercial interests of Perth Amboy justify the increased expenditure, this can be done without any great additional cost for dredging.

The following is the estimate of cost of opening by means of dredging a channel 300 feet in width and 21 feet in depth at mean low-water, to connect the deep water of the main ship-channel with the deep water to the west of Seguine Point:

Dredging 460,000 cubic yards of mud, at 25 cents per cubic yard	$115,000
Engineering and contingencies, at 10 per cent	11,500
Total	126,500

The execution of the detailed instrumental survey was intrusted to Assistant Engineers M. A. Lacy and Frank D. Y. Carpenter.

Very respectfully, your obedient servant,

A. DOERFLINGER,
Principal Assistant Engineer.

Lieut. Col. N. MICHLER,
Corps of Engineers, Bvt. Brig. Gen., U. S. A.

Summary statement showing the number and tonnage of vessels entering into and clearing from the port of Perth Amboy with cargoes; the number owned and documented in the district, with tonnage; and the number of men employed in navigation of same, for fiscal year ending June 30, 1879.

Vessels.	Number.	Tonnage.	No. of men employed.
Entered coastwise	199	43 765	1,028
Cleared coastwise	90	18,547	347
Entered from foreign ports (American)	4	1,567	29
Entered from foreign ports (foreign)	9	4,474	98
Cleared to foreign ports (American)	40	15,286	270
Cleared to foreign ports (foreign)	25	8,713	153
Documented in district	560	46,485	2,284
Totals	927	135,837	4,209

CUSTOM-HOUSE, PERTH AMBOY, N. J.,
Collector's Office, February 21, 1880.

Value of merchandise exported to foreign countries from the district of Perth Amboy, New Jersey, viz:

1878	$134,081 00
1879	134,657 00
And 6 months of 1879	16,889 00

Value in gold of merchandise imported into the district of Perth Amboy, New Jersey, viz:

1875	$12,589 69
1876	9,816 11
1877	3,533 00
1878	4,503 00
1879	17,980 00
And for 6 months ending December 31, 1879	42,985 85

Respectfully submitted.

CHARLES H. HOUGHTON,
Collector.

E 10.

IMPROVEMENT OF MATTAWAN CREEK, NEW JERSEY.

The survey of this creek was directed by the river and harbor act of June 14, 1880, and on January 3, 1881, a project and estimate for the improvement of the creek from Raritan Bay, at Keyport, to the head of navigation, at the crossing of the New York and Long Branch Railroad bridge, was submitted to the Chief of Engineers by me. By the river and harbor act of March 3, 1881, an appropriation of $15,000 was made, and this amount will be applied to dredging the channel through the flat at the mouth of the creek, 100 feet wide and 4 feet deep at mean low-water, and to dredging the channel above Winkson Creek, as far as the funds available will permit.

The amount asked for the year ending June 30, 1883, will be applied to continue the dredging as contemplated by the existing project.

The work is in the collection district of Perth Amboy. Nearest port of entry, Perth Amboy; nearest light-house, Princess Bay. Fort at Sandy Hook is the nearest fort.

Amount of revenue collected at Perth Amboy during the fiscal year ending June 30, 1881, $37,456.74.

Money statement.

Amount appropriated by act approved March 3, 1881	$15,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	267 28
July 1, 1881, amount available	14,732 72
Amount (estimated) required for completion of existing project	18,120 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	18,120 00

Abstract of proposals for dredging in Mattawan Creek, New Jersey, opened June 17, 1881, *by Lieut. Col. N. Michler, Corps of Engineers.*

Number.	Names of bidders.	Quantity cubic yards.	Price per cubic yard.	Date of commencement.	Date of completion.
1	William Flannery	48,000	$0 77	Not given	Not given.
2	John McDermott	48,000	1 20	do	Do.
3	Thomas H. Benton	48,000	0 85	do	Before end of fiscal year.
4	Elijah Brainard, jr	48,000	0 91	October 1, 1881	June 30, 1882.
5	John Van Patten	48,000	0 48	September 15, 1881	May 30, 1882.

Contract awarded John Van Patten, the lowest bidder, with the approval of the Chief of Engineers.

SURVEY OF MATTAWAN CREEK, FROM RARITAN BAY CHANNEL TO CENTRAL RAILROAD BRIDGE, HEAD OF NAVIGATION.

UNITED STATES ENGINEER OFFICE,
New York, January 3, 1881.

GENERAL: Section 2 of the river and harbor act, approved June 14, 1880, directs the Secretary of War to cause an examination or survey, or both, to be made of "Mattawan Creek, from Raritan Bay channel to Central Railroad bridge, head of navigation."

This stream is designated on Coast Chart No. 2, New York Bay and Harbor, as Middletown Creek, and empties into the bay a short distance west of Keyport, N. J. It was decided to make a careful survey of the locality so as to decide upon the nature of the improvement to its channel, should any be deemed necessary.

The accompanying report of Assistant Engineer Doerflinger furnishes in detail the manner in which the survey of the creek was conducted, and proposes the only plan by which its navigation can be improved for the benefit of the adjacent country, together with an approximate estimate of the cost of the undertaking. The inclosed map supplies all additional information as to the nature of the banks, the meanderings of the stream, and the soundings reduced to the plane of mean low-water; it also indicates the localities, as well as the limits and extent of the sections to be dredged, should it be deemed advisable to prosecute the work. At present the locality is accessible by the New York and Long Branch division of the Central Railroad; a steam propeller also plies daily at some seasons of the year, and at others tri-weekly, between the creek and New York, and a few sailing vessels and canal-boats are employed. The principal articles of shipment are country produce, assorted merchandise, brick, lumber, coal, lime, iron ore, and wood; these are valued, at present, at about $800,000 annually. By the proposed enlargement of the channel-way and increased facilities for shipping goods, it is computed that there would be a growth in the commerce of from one-third to one-half, and that a large portion of Monmouth County would be benefited. Manufacturers would also be induced to locate there, as inquiries have already been made as to whether the creek is easy of access by water. It is estimated that $33,120 will be required for the completion of this work of improvement.

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Very respectfully, your obedient servant,

N. MICHLER,
Lieutenant-Colonel of Engineers,
Bvt. Brig. Gen., U. S. A.

The CHIEF OF ENGINEERS, *U. S. A.*

REPORT OF MR. A. DOERFLINGER, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
New York, January 3, 1881.

SIR: I have respectfully to submit the following report on the survey of Mattawan Creek, New Jersey:

The field work embraced the course of the creek from its mouth, where it discharges into Raritan Bay at Keyport, to the head of navigation, at the crossing of the New York and Long Branch Railroad bridge, a distance of 2 miles. The bed of the stream lies generally through low marsh and meadow lands, the average level of which is about that of mean high-water. It is a characteristic feature of the stream, and one very favorable to its navigation, that its course is less sinuous than is generally found in streams of this class; this sinuosity, in addition to the shoal water generally found, makes navigation difficult on account of the many sharp bends that are encountered.

* * * * * * *

The plane of mean high and low water at Keyport having been already established by observations made under the direction of Col. John Newton, Corps of Engineers, in 1872, no additional ones were necessary; two tide-gauges were, however, set up, one at Mattawan Dock, Keyport, and the other on the railroad bridge at the upper limit of the survey; these were connected by a line of levels with the bench-mark at Keyport, as established by the survey of 1872. From simultaneous observations made on these gauges it was found that the tidal wave on its passage up the creek undergoes but little change, the range being practically the same at both gauges; this shows that no undue obstruction to the tidal flow exists between the two points, and accounts for the generally good depth of water found in the lower part of the creek. From the mouth of the Mattawan up that of Winkson Creek, where the latter empties into the main stream, between 4 and 5 feet of water at low-tide can be carried with from 50 to 75 feet, between the curves of 4 feet. Above Winkson Creek the 4-foot curve contracts very rapidly, and finally disappears, only occasional spots, with a depth of 4 feet occurring further up stream. Between the mouth of the main creek and Mattawan Dock, Keyport, the 4-foot curve is again interrupted by a mud flat with only from 2 to 3 feet depth of water in the channel across the same. A channel of 4 feet at mean low-water and about 100 feet in width across this flat, together with a deepening of the channel above Winkson Creek to the same depth and to a width of 75 feet, would probably meet all the present requirements of the shipping interests of the locality. A steamboat now plies regularly between Ellis Dock and New York City, her general freight being garden produce from the rich farms of Monmouth County. The other shipping of the creek consists principally of brick from the factories located along and adjacent to it. This traffic is generally carried on in sloops and schooners drawing from 4 to 7 feet. A 4-foot channel would allow the smaller of these vessels to ascend the creek at or near low-water, and the larger at about half-tide. The most practicable plan of executing any desired improvement is by widening and deepening the channel by means of dredging. It may be necessary, however, to renew this operation from time to time, especially across the flat at the mouth of the creek. Owing to the difficulty of disposing of the dredged material, and the shoal water in which the operations are to be carried on, the cost of dredging will be high; probably not less than 60 cents per cubic yard.

The estimated cost of the improvement is as follows:

	Cubic yards.
Dredging channel through flat at the mouth of the creek 100 feet wide and 4 feet deep at mean low-water	12,000
Dredging channel from Winkson Creek to Central Railroad bridge 75 feet wide and 4 feet deep at mean low-water	36,000

SUMMARY.

To 48,000 cubic yards of dredging, at 60 cents per cubic yard	$28,800
To contingencies and engineering, 15 per cent	4,320
Total estimated cost of improvement	33,120

Very respectfully, your obedient servant,

A. DOERFLINGER,
Principal Assistant Engineer.

Bvt. Brig. Gen. N. MICHLER,
Lieutenant-Colonel of Engineers, U. S. A.

E 11.

IMPROVEMENT OF HARBOR AT PLATTSBURGH, NEW YORK.

Under the appropriation of March 3, 1879, together with that of June 14, 1880, the depth of water has been increased by dredging upon the shoals lying nearest the breakwater, between the north and south wharves and along the approach of the "Slip" and the sand-bar at the southeast corner of the south wharf, to 8 feet at mean low-water of the lake; but as the lake, during September and October, 1880, by reason of the great drought prevailing in the vicinity, was 1 foot lower than its usual minimum, there were places in the harbor where but 7 feet of water was had. Consequently, the larger class of vessels, during this period, found it difficult to move about the harbor.

In making an unsuccessful attempt to dredge off these shoal places, which are composed of hard pan (the original bottom), the dredge employed, and the only one available in the lake, breaking down, was hauled off for repairs, its machinery being too light for this class of dredging. To prevent the recurrence of this state of things, it is proposed, during the season, to apply the unexpended balance of the last appropriation for this work to dredging off these prominent places.

Plattsburgh is in the collection district of Champlain, and is a port of entry. Nearest light-house, Cumberland Head; beacon lights are maintained upon either end of the breakwater in this harbor. Fort Montgomery, Rouse's Point, N. Y., is the nearest fort.

Amount of revenue collected at this port during the fiscal year ending June 30, 1881, is ———.

ORIGINAL ESTIMATE.

Extension of breakwater, 400 linear feet	$40,000 00
Revetment of the United States reservation	7,000 00
Dredging	16,000 00
Contingencies	2,000 00
	65,000 00

AMOUNTS APPROPRIATED.

By act of Congress approved July 11, 1870	$10,000 00
By act of Congress approved March 9, 1871	15,000 00
By act of Congress approved June 10, 1872	10,000 00
By act of Congress approved March 3, 1873	10,000 00
By act of Congress approved June 23, 1874	5,000 00
By act of Congress approved March 3, 1879	2,000 00
By act of Congress approved June 14, 1880	1,000 00
Total	53,000 00
Amount expended	51,227 58

Money statement.

July 1, 1880, amount available	$3,879 91
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,107 58
July 1, 1881, amount available	1,772 33
Amount (estimated) required for completion of existing project	12,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	5,000 00

E 12.

IMPROVEMENT OF HARBOR AT BURLINGTON, VERMONT.

The superstructure of the 111 linear feet of breakwater extension has been completed. Under the appropriation of June 14, 1880, the crib-work of 70 linear feet of breakwater extension has been constructed, sunk in position, and about three-fourths of the stone filling put in, the work being done by the purchase of material in open market, and by hired labor. The superstructure of this extension will be put in as soon as the lake shall have reached a sufficiently low stage to enable the work to be prosecuted with advantage. With the appropriation of March 3, 1881, it is proposed to continue the extension of the breakwater in a northwesterly direction.

This work is in the collection district of Vermont. Burlington is a port of entry. Nearest light-house, Juniper Island; beacon lights are also maintained on either end of the breakwater in this harbor. Fort Montgomery, Rouse's Point, N. Y., is the nearest fort.

Amount of commerce and navigation to be benefited by this improvement, $———.

ORIGINAL ESTIMATE.

For 2,000 linear feet of breakwater extension, as recommended in the report of Col. John Newton, Corps of Engineers, in 1874	$340,000 00

AMOUNTS APPROPRIATED.

By act of Congress approved March 3, 1875	$25,000 00
By act of Congress approved August 14, 1876	20,000 00
By act of Congress approved June 18, 1878	20,000 00
By act of Congress approved March 3, 1879	15,000 00
By act of Congress approved June 14, 1880	10,000 00
By act of Congress approved March 3, 1881	10,000 00
Total	100,000 00
Amount expended	86,208 66

Money statement.

July 1, 1880, amount available	$17,295 53	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$27,295 53
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		13,504 19
July 1, 1881, amount available		13,791 34
Amount (estimated) required for completion of existing project		250,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		40,000 00

E 13.

IMPROVEMENT OF SWANTON HARBOR, VERMONT.

The work of widening the foundation of the breakwater by the purchase and application of rubble-stone has been completed. With the appropriation of March 3, 1881, together with the unexpended balance of the previous appropriations, it is proposed to complete the repair of this breakwater.

Swanton Harbor is in the collection district of Vermont. Nearest port of entry, Alburgh, Vt. Fort Montgomery is the nearest fort. The nearest light-house, Isle Lamotte, Vermont.

The amount of commerce and navigation to be benefited by this improvement, $———.

ORIGINAL ESTIMATE.

1,900 linear feet of breakwater	$240,000 00

AMOUNTS APPROPRIATED.

By act of Congress approved March 3, 1873	$15,000 00
By act of Congress approved June 23, 1874	8,000 00
By act of Congress approved March 3, 1875	10,000 00
By act of Congress approved August 14, 1876	2,000 00
By act of Congress approved June 18, 1878	20,000 00
By act of Congress approved March 3, 1879	6,000 00
By act of Congress approved June 14, 1880	2,500 00
By act of Congress approved March 3, 1881	2,500 00
Total	66,000 00
Amount expended	59,651 74

Money statement.

July 1, 1880, amount available	$5,635 92	
Amount appropriated by act approved March 3, 1881	2,500 00	
		$8,135 92
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		1,787 66
July 1, 1881, amount available		6,348 26
Amount (estimated) required for completion of existing project		174,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		15,000 00

E 14.

IMPROVEMENT OF OTTER CREEK, VERMONT.

During the early part of the season an examination of this stream was made by a series of soundings extending from the foot of the falls, Vergennes Basin—to Fort Cassin Point, the outlet of the creek, by which it was found that improvements were needed at Vergennes Basin, Bullbrook and Brickyard bends. In the basin, an increased depth of water being needed at the steamboat landing; the irregular formations on either side of the channel from the steamboat landing to the upper coal dock removed; the navigation in the vicinity of the upper coal dock, and extending along the west shore of the basin to the Horse Nail Factory, improved. At Bullbrook and Brickyard bends the channel needs both widening and straightening.

The dredge employed to do the work in this stream and at Plattsburgh Harbor (the only available one in this vicinity), breaking down while at work in the latter place in October, was hauled off for repairs, and before these repairs could be effected the season had become so advanced that it was thought advisable to postpone operations until the following season.

It is now proposed to resume operations and effect these needed improvements as early as practicable.

Vergennes is in the collection district of Vermont. Nearest port of entry, Burlington, Vt; nearest light-house, Split Rock. Fort Montgomery, Rouse's Point, N. Y., is the nearest fort.

Amount of commerce and navigation to be benefited by this improvement, $———.

ORIGINAL ESTIMATE.

Dredging, dike and fascine work	$57,646 00
Removing trees	500 00
	58,146 00

AMOUNTS APPROPRIATED.

By act of Congress approved June 10, 1872	$10,000 00
By act of Congress approved March 3, 1875	5,000 00
By act of Congress approved June 18, 1878	8,000 00
By act of Congress approved March 3, 1879	5,000 00
By act of Congress approved June 14, 1880	2,000 00
By act of Congress approved March 3, 1881	2,000 00
Total	32,000 00
Amount expended	23,569 09

Money statement.

July 1, 1880, amount available	$8,130 65	
Amount appropriated by act approved March 3, 1881	2,000 00	
		$10,130 65
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		1,699 74
July 1, 1881, amount available		8,430 91
Amount (estimated) required for completion of existing project		26,146 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		5,000 00

E 15.

IMPROVEMENT OF TICONDEROGA RIVER, NEW YORK.

Under the appropriation of March 3, 1881, it is proposed to begin the improvement of this river in accordance with the recommendations made in the report of survey and examination of the same submitted under date of January 10, 1881.

To dredge a channel from the railroad bridge extending eastwardly to 8-foot curve, and to improve the channel from the railroad bridge to the foot of the falls.

Ticonderoga, N. Y., is in the collection district of Champlain. Nearest port of entry, Burlington, Vt.; nearest light-house, Crown Point; and nearest fort, Fort Montgomery, Rouse's Point, N. Y..

Amount of commerce and navigation to be benefited by this improvement, $———.

ESTIMATED COST OF IMPROVEMENT, 1880.

Dredging	$27,290 71
Pile revetment of cut below railroad bridge	9,680 00
Contingencies	5,545 29
Total	42,516 00

AMOUNT APPROPRIATED.

By act of Congress approved March 3, 1881	$5,000

Money statement.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	34 55
July 1, 1881, amount available	4,965 45
Amount (estimated) required for completion of existing project	37,516 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	10,000 00

SURVEY OF TICONDEROGA RIVER, NEW YORK.

UNITED STATES ENGINEER OFFICE,
New York, January 10, 1881.

GENERAL: The act, approved June 14, 1880, "making appropriations for the construction, repair, completion, and preservation of certain works on rivers and harbors," authorizes, in one of its sections, the Secretary of War to cause an examination or survey, or both, to be made of Ticonderoga River, New York, and to submit an estimate of the plan and cost of any improvement of the same, should it prove advisable to make any. This duty having been assigned to me, instructions were given to Assistant Engineer D. White to make a detailed survey of the river. His report, together with a tracing of the map prepared by him, are herewith inclosed, and respectfully submitted for the information of the Chief of Engineers. As they afford so much useful information in regard to the past and present navigation of the river, and furnish such reliable statistics concerning the extensive manufacturing interests centered along it, presenting at the same time a comprehensive plan of improvement to meet any present requirements, with the estimated cost of the same, the subject becomes one of considerable importance, and worthy of a favorable consideration. In the future, should the commercial interests demand it, a continuous channel-way connecting the waters of Lakes George and Champlain might be made available by the construction of locks to overcome the several intervening waterfalls. The estimated cost of dredging a new channel-way at such points as are necessary throughout the entire length of the river, and of the protection by piling of one of the sections near its outlet into Lake Champlain, is placed at $42,516.

Very respectfully, your obedient servant,

N. MICHLER,
Lieut. Col. of Engineers, Bvt. Brig. Gen., U. S. A.

The CHIEF OF ENGINEERS, *U. S. A.*

REPORT OF MR. D. WHITE, ASSISTANT ENGINEER.

FORT MONTGOMERY, ROUSE'S POINT, NEW YORK,
December 28, 1880.

SIR: I have the honor to submit the following report of the examination of Ticonderoga River, New York, made in conformity with your instructions, "For the purpose of making an examination and estimate of the cost of improvement proper to be made at that point." Ticonderoga River is wholly within Essex County, New York, and lies in a deep valley formed by the foot-hills of the Adirondack Mountains, which tower up from its banks on either side. It has a length of about 3 miles, and extends in a circuitous course, northeasterly to southeasterly, from the northern end of Lake George through the village of Ticonderoga, where it forms a "basin" at the foot of the falls. This part of the river is about 1 mile in length, and has an average width of about 90 feet. From Ticonderoga for a distance of 2 miles, with a varying width between banks of from 125 to 1,800 feet, it flows in an easterly direction, emptying into Lake Champlain 25 miles north of Whitehall, the head of the lake. This stream conveys the waste waters of Lake George, together with the drainage of the adjacent hills, to Lake Champlain. Its declivity from Lake George to the basin is 222 feet, consisting of five consecutive water-falls; these are said to have an average flow amounting to 26,700 cubic feet per minute, thus affording an almost unlimited amount of power for purposes of manufacture. Its current below the falls, however, is sluggish, and evidently too feeble to produce any very material scouring effect upon its bed.

In consequence of ice at the time of the survey the velocity of the current could be determined in the basin only, where it was found to amount to 6,800 feet per hour. Its velocity is probably not much greater at any time, as the stream is not subject to violent freshets, owing to the presence of a dam across the outlet of Lake George; this converts the lake into a storage reservoir for the surplus waters at spring and fall, and the discharge is regulated by gates in the dam. About 1⅝ miles below Ticonderoga village there was extended across the river in 1873–'74 an embankment forming a part of the New York and Canada Railroad, which skirts the western shore of Lake Champlain. In this embankment, at the north bank of the stream, there is a drawbridge with openings of 30 and 50 feet respectively, at either side of the central pier, for the egress of the waters and the passage of boats.

As will be seen by the chart herewith respectfully inclosed, the water-way both above and below the railroad embankment has become so contracted and filled by flats or "intervals" as to reduce its width to about 120 feet and its depth has become so shallow as to render navigation almost impracticable.

The surface of the flats or intervals is about six inches above the plane of low-water; these are covered with a heavy growth of marine plants, and in some cases with young willows. On an examination of the flats the strata of deposit is found to vary in depth from 10 to 20 feet, and their nature as well as that affecting the water-way is as follows: In the basin, sand, clay, gravel, and mud; below the basin to the railroad embankment, silt, sand, gravel, and mud, with a small percentage of saw-mill *débris*; below the railroad embankment, saw-mill *débris* and silt. The manufacture of lumber on this stream, was, as I am informed, commenced in 1756, a saw-mill having been erected on the falls in that year by the French, the second by the English in 1763, and a flouring-mill in 1772. From 1771 up to the present time there have been not less than two, and at times sixteen, saw-mills in operation, constantly washing their *débris* into the stream. This, together with the material washed down from the slopes of the surrounding hills for more than a century, has resulted in nearly destroying its navigation. Up to 1836 sail crafts and steamboats could reach the foot of the falls, since that date, however, by the gradual growth of shoals, vessels have been obliged, from time to time, to relinquish a higher for a lower landing place in the river, until the last steamer plying between Ticonderoga and Whitehall for freight and passengers ceased running with the season of 1878. At present vessels partly laden go up to the Cassey Dock.

In the spring of the year, when Lake Champlain is at its maximum, and the river thereby swollen, boats with full cargo can reach the foot of the falls. The freight business of Ticonderoga is, consequently, carried on by railroad transportation through "Addison Junction Station," on the New York and Canada Railroad, 2 miles east of the village; the latter is then reached by a clay road over an elevation of 150 feet. Occasionally special freights are brought over the Lake George branch into the village. This branch was built for the transportation of passengers during the months of summer travel; it has a grade of 150 feet in the first mile and 100 in the second, and extends from "Fort Marshall," on Lake Champlain, to "Baldwin," on Lake George, 5 miles distant. Ticonderoga is a manufacturing, mining, and milling village, of about 3,000 inhabitants. Its principal manufactories are as follows: Two woolen mills, two cotton mills, three pulp mills, two flouring mills, two saw-mills, one graphite mill, key mill, machine shop and foundry, and an iron forge.

The mining is of iron ore at a locality west of the village and about 5 miles distant; emery, about half a mile southeasterly; graphite, used by Dixon & Co. for pencils and crucibles, about 4 miles west, and at Hagen, 8 miles south of the village. Its importance will be best shown by the certified statement herewith transmitted of the business done in 1879. This statement was furnished by three of its leading men; a summary of which gives 37,586 tonnage, and $1,156,223 as the money value of its business for the year. From the above facts it will be seen that the village is already a thriving place, but almost entirely dependent upon a railroad, whose station is 2 miles distant from the village, for the transportation of its raw material and manufactured wares; this is attended with much expense and inconvenience. In view of the foregoing facts it is proposed to give to the business interests centered here the additional facilities of water transportation, which its importance would seem to require, by making the following improvements to the navigation of the river:

In the first place to dredge a channel 100 feet in width and to a depth of 8 feet at mean low-water, the depth required for vessels engaged in the commerce of Lake Champlain, from the 8-foot curve at the outlet to the railroad bridge, as indicated by the dotted line on the chart. In the second place to dredge the channel 60 feet wide and 8 feet deep from the railroad bridge to the foot of the falls. Afterwards in front of Cassey and Bishop docks, and from the pulp mill extending 400 feet northwardly along the right shore of the basin, to widen this channel to 100 feet; then from the 60-foot channel extend another cut 100 feet wide diagonally across the basin to the north end of the old dock, at the iron forge; and thence parallel to the face of the dock for 200 feet and 100 feet in width, as shown by the dotted lines in the chart. The river thus improved would, I think, meet all the present requirements of commerce; and the improvement of the basin could be enlarged from time to time as the development of business may demand. The cut from the railroad bridge to the 8-foot curve will probably need revetting to prevent its refilling. For this purpose a line of piling is proposed for each side of the cut, the two lines 100 feet apart; the piles of each line to be driven close to each other, and connected at top by waling timbers bolted to them.

ESTIMATED COST OF THE FOREGOING IMPROVEMENTS.

For dredging 32,592 cubic yards of saw-mill *débris* and silt, at the outlet, at 18c. per cubic yard	$5,866 56
Dredging 85,697 cubic yards of material in the channel and basin, from the drawbridge to the foot of the falls, at 25c	21,424 15

For 3,520 piles, 27 feet long, at $1.35 each	$4,752 00
Driving 3,520 piles, at $1 each	3,520 00
Waling timbers, 6 by 12 inches, 26,400 feet, board measure, including sawing and labor, at $20 per M	528 00
3,520 $\frac{3}{4}$-inch bolts, 15 inches long, at 25c. each	880 00
Contingent	5,545 29
	42,516 00

Ticonderoga village is in the collection district of Champlain; nearest port of entry, Burlington, Vermont; nearest light-house, Crown Point; and the nearest fort, Fort Montgomery, at the outlet of Lake Champlain.

Very respectfully, your obedient servant,

D. WHITE,
Assistant Engineer.

Lieut. Col. N. MICHLER,
Corps of Engineers, Bvt. Brigadier-General, U. S. A.

Statement of the annual commerce, viz, exports and imports, of the village of Ticonderoga, Essex County, New York, located on the Ticonderoga River.

Names of corporations and firms.	Tonnage.	Value.	Remarks.
Horicon Iron Company	12,500	$59,500	Iron and iron ore.
Ticonderoga Pulp Company	4,000	30,750	Wood, coal, and pulp.
American Graphite Company	3,000	30,000	Lead.
Lake George Manufacturing Company	1,026	289,668	Cotton, cloth, &c.
Glens Falls Pulp Company	2,500	27,750	Wood and pulp.
Lake George Pulp Company	1,500	30,500	Do.
Lake Champlain Manufacturing Company	500	13,000	Lumber, &c.
Ticonderoga Woolen Mills	320	120,310	Wool and cloth.
William Hooper & Co	500	50,000	Machinery, &c.
Patterson & Merchant	504	11,075	Grain and plaster.
George C. Weed	1,620	13,000	Lumber.
W. D. Coates	1,980	19,500	Do.
Peck & Howard	1,500	21,600	Do.
John Jalet	500	12,500	Do.
Needham Brothers	300	4,620	Spool stock.
Gilligan & Stevens	3,755	100,750	Shippers, &c.
26 mercantile firms	1,281	268,700	Merchandise.
All other shippers	300	50,000	Horses, &c.
Total tons and value	37,586	1,156,223	

E 16.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

The Dutch bark Samarang, loaded with grain, was sunk by collision with the steamer Germanic, November 7, 1880, the wreck lying on the east side of the South Channel entrance to New York Harbor, in about 22 feet of water. Instructions were received from the Chief of Engineers, November 22, directing that steps be taken for the immediate removal of the wreck. In accordance therewith a contract was entered into with Atlantic Dredging Company for its removal, together with the cargo. On February 8, 1881, the contractors' plant was taken to the buoy placed by Rear Admiral Nichols, inspector third light house district, to mark the position of the wreck, and preparations were made to commence operations at once. An attempt was made to find the wreck with the sounding line from a yawl-boat, but had to be abandoned owing to the great quantity of drift-ice. The weather looking very threatening, it was decided by the contractors to return with their plant to New York until such time as the position and condition of the wreck could be definitely determined. An examination subsequently made, under the direction of Rear Admiral Nichols, revealed the fact that not a vestige of the wreck could be found near the locality where the same went down, and that in all probability it had been broken up by the action of the waves and the fragments carried out to sea or washed ashore. As no complaints have been heard from pilots or others, it is believed that no portion of the wreck has lodged in any of the channels leading to New York Harbor.

E 17.

EXAMINATION AND SURVEY OF SHARK RIVER, NEW JERSEY.

UNITED STATES ENGINEER OFFICE,
New York, January 3, 1881.

GENERAL: Section 2 of "An act making appropriations for the construction, repair, completion, and preservation of certain works on rivers and harbors, and for other purposes," approved June 14, 1880, directs the Secretary of War to cause an examination or survey, or both, and an estimate of the cost of improvement, to be made of "Shark River, New Jersey."

The inclosed report of Assistant Engineer Doerflinger, in connection with the accompanying map of the river, furnishes all desired information in regard to the detailed survey.

As will be fully understood from the facts as presented, the actual condition of the commercial interests of the immediate locality and of the adjacent country does not appear to justify the expenditure of the large amount necessarily required to construct such works as would render the small harbor formed by the lower basin of Shark River either accessible to seagoing vessels, or sufficiently commodious for anchorage ground. Under the present condition of affairs it does not seem advisable to undertake any work of improvement, and therefore no project is submitted for the consideration of the Chief of Engineers.

Very respectfully, your obedient servant,

N. MICHLER,
Lieutenant-Colonel of Engineers,
Bvt. Brig. Gen., U. S. A.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. A. DOERFLINGER, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
New York, January 2, 1881.

SIR: I have the honor to submit the following report on the examination and survey of Shark River, New Jersey:

Shark River discharges into the Atlantic Ocean about 20 miles miles south of Sandy Hook. It extends inland nearly 10 miles, and drains a comparatively small section of the adjacent country. Some 2 miles above its mouth it enlarges from a narrow stream to a basin over a mile wide, and of nearly the same length. The depth of this basin varies from 1 to 3 feet. At its lower end its width contracts to about 900 feet, but the actual water section is still further reduced to about 600 feet by islands of low marsh lands; the tidal flow is further obstructed by the piles and timbers of the wooden trestle-bridge of the Long Branch Railroad, which spans the river at this point. Five hundred feet below the latter structure again the river is crossed by a second wooden trestle-bridge, the length of which is 900 feet. Neither of these bridges is provided with a draw, and they therefore shut off all communication, other than by row-boats, between the upper basin and the lower portion of the river. The section immediately above the mouth is the one had under examination with a view to its improvement.

* * * A glance at the map shows that the river bed, which consists of sand, is very irregular in figure, being made up of a series of pools from 4 to 8 feet deep, and of shoals dry at low-water. The inlet, at the date of the survey, had the position shown on the chart, the bar on the outside being dry at low-water, and was slowly working to the northward in a manner characteristic of similar ones along this coast. This shifting tendency of the inlet accounts in a measure for the irregularity of the river bottom; since, as the position of the inlet changes, the force and direction of the tidal currents are also changed, and thus new channels are scoured out and new shoals thrown up.

Owing to the limited amount available for the purposes of the survey, no extended series of tidal observations were made; two gauges were, however, set up, one directly inside of the inlet and the other at the railroad bridge, and observed simultaneously during the progress of the survey. The time of change of current in the inlet and at the railroad bridge was also noted. From these observations it was found that the average rise and fall of tides at the inlet is $1\frac{4}{10}$ feet, which decreases to $\frac{7}{10}$ of a foot at the bridge. The rise and fall of tide in the ocean at this point is about 4 feet. This great difference in the tidal range gives rise to strong currents in the inlet, the velocity of which, by observations made on surface floats, was found to be 5 miles per hour. Although no systematic series of current observations were made, the following considerations seem to warrant the conclusion that the flood current is considerably stronger than the ebb. The mean duration of fall of tide was found to be 7^{h} 20^{m}, and mean duration of rise 5^{h} 6^{m}. Also mean duration of ebb current 8^{h} 10^{m}, whilst the mean duration of flood current is but 4^{h} 15^{m}. As the average volume of water passing in through the inlet is equal to that passing out, less the fresh-water discharge of the river, the latter being very small compared to the tidal prism, and as it takes nearly twice as long to discharge this volume as it takes the same to pass in throug the inlet, the above conclusion seems justified. The flood current being stronger than the ebb, the natural tendency of the current action must be that the material removed by scour will, under the preponderating action of the flood current, work its way up stream, new shoals in the river and in the basin being the result of this action.

To secure permanency to the inlet and a modification of the existing current conditions must, therefore, be essential features of any plan of permanent improvement. To effect this object would necessarily involve the construction of extensive works, the cost of which would be entirely disproportionate to any benefits to be derived from the improvement. As far as could be learned, the river at present is entirely without commerce, and no commercial or agricultural interests would be benefited, even were the inlet in a condition to admit light-draught vessels to enter and pass out of the same. The river at present is available only for the use of fishing and pleasure boats during the warm season, the greater number of which are owned and used by residents of Ocean Beach, a summer resort located on the south shore of the river.

I am, very respectfully, your obedient servant,

A. DOERFLINGER,
Principal Assistant Engineer.

Lieut. Col. N. MICHLER,
Corps of Engineers, Bvt. Brig. Gen., U. S. A.

APPENDIX F.

IMPROVEMENT OF DELAWARE AND SCHUYLKILL RIVERS; OF THE SUSQUEHANNA ABOVE RICHARD'S ISLAND, AND RIVERS IN NEW JERSEY AND DELAWARE—HARBOR IMPROVEMENTS IN DELAWARE RIVER AND BAY—CONSTRUCTION OF PIER AT LEWES—DELAWARE BREAKWATER.

REPORT OF COLONEL J. N. MACOMB, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1881, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

UNITED STATES ENGINEER OFFICE.
Philadelphia, Pa., September 20, 1881.

GENERAL: In conformity with the requirements of General Orders No. 1, dated Headquarters Corps of Engineers, United States Army, Washington, D. C., May 26, 1881, I have the honor to transmit herewith the annual reports on the surveys and examinations, and the several works of improvement of rivers and harbors intrusted to my care, for the fiscal year ending June 30, 1881.

In transmitting these reports I desire to acknowledge the services of Capt. W. Ludlow, Corps of Engineers, U. S. Army, to whom I am indebted for the intelligent, zealous, and cheerful manner in which he has forwarded these works during the past fiscal year.

I remain, very respectfully, your most obedient servant,

J. N. MACOMB,
Colonel of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

F I.

IMPROVEMENT OF DELAWARE RIVER BETWEEN TRENTON, NEW JERSEY, AND BRIDESBURG, PENNSYLVANIA.

The act of June 14, 1880, appropriated $10,000 for continuing this improvement.

The Delaware River at Bordertown is divided into two channels, of which the western one is used for the up-river traffic to Trenton, and the eastern one is the outlet for the Delaware and Raritan Canal.

Both are shallow and for the improvement a selection had to be made.

The eastern channel, into which the canal debouches, would be equally available for the general traffic as well.

In 1878 it was, therefore, determined to open this and deepen it to 7 feet at low-water for the benefit of the canal navigation, and continue the work with the view of making it the main channel of the river. Dredging began in 1878 and the canal traffic was relieved. As the work progressed it was found necessary to build two dikes for the purpose of preventing a portion of the river flow from passing around Duck Island and entering the channel from the other side with injurious effect.

The dikes were built in 1879 with good results, both in their immediate vicinity and to the dredged channel below, in which operations were continued.

Contract was made in August, 1880, with Mr. Herron, at 22 cents per cubic yard. The channel as projected having a length of 1,500 yards, width of 50 yards, and depth of 7 feet at mean low-water.

By November 20, when the presence of heavy ice drove off the dredge, 30,000 cubic yards had been removed.

The ensuing winter was exceptionally severe and its effects were especially noticeable in the vicinity of Bordentown. A heavy gorge formed at Kincora Bar about 2½ miles below, backing up the river to an unusual extent, and a second gorge at Periwig, about the same distance above and close to the new dikes, which threw the whole force of the river and the heavy running ice against them, the ice and water flowing over them to a depth of 6 or 7 feet, tearing off the cap timbers and successively some of those below, and carrying out a considerable amount of the gravel filling and backing.

The improved channel below, however, exhibited a gratifying stability.

Dredging was resumed in April, 1881, and continued until near the end of the month, when the appropriation was exhausted, 47,645 cubic yards having been removed under the contract of 1880.

On June 30, 1881, the 7-foot channel from the canal entrance upwards was within 800 feet of the 7-foot curve abreast of Duck Island.

With a portion of the $10,000 appropriation of March 3, 1881, the restoration of the dikes was nearly completed in May and June.

The bids received in response to advertisement of May 11, for continuing dredging operations were rejected as excessive and a special agreement was finally made with Mr. Herron to dredge all sand salable for building purposes at 22 cents, and at 50 cents for other material, not salable, to be landed on the shore.

The contract is to be completed during the present season and should carry the 7-foot channel through to abreast of Duck Island.

As has been heretofore reported, it is probable that a deflecting dike from the Pennsylvania shore will utimately be required to partially obstruct the flow down the west channel and direct it into the one under improvement.

The river bed in this vicinity is nearly clear sand, permeated with springs, and easily acted upon by water in motion.

Dredging in such material is simple enough as a mechanical operation, but the results of the dredging are more obscure. The liveliness of the sand is such that a general lowering of the river bed is effected in the vicinity of the dredge, rendering it difficult to deepen within fixed limits and to make the advances due to actual amount of excavation.

The indications of stability, however, are better than might be expected with such material.

For the continuance of the improvement, including the survey of the river to Trenton, and the dredging at Kincora Bar hitherto estimated for but not accomplished on account of the lack of funds and the predominance of the Bordentown dredging, an appropriation of $25,000 is required for fiscal year 1882-'83.

This improvement is in the collection district of Burlington, N. J., which is also the nearest port of entry. The nearest fort and light house are, respectively, Fort Mifflin and Fort Mifflin light.

Total amount appropriated to June 30, 1881	$81,000 00
Total amount expended to June 30, 1881	70,995 38

Money statement.

July 1, 1880, amount available	$10,002 42	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$20,002 42
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	9,995 38	
July 1, 1881, outstanding liabilities	323 63	
		10,319 01
July 1, 1881, amount available		9,683 41
Amount that can be profitably expended in fiscal year ending June 30, 1883.		25,000 00

COMMERCIAL STATISTICS.

The navigation of the Upper Delaware River depends chiefly upon the business of the two canals which have outlets into the river, one at Bordentown, N. J., and the other at Bristol, Pa.

The Upper Delaware and the Delaware and Raritan Canal, which has an outlet at Bordentown, N. J., forms one of the navigable routes between Philadelphia and New York for steamers, sailing vessels, barges, &c.

During the year 1879 the number of vessels passing in and out of the river at the outlet of the canal at Bordentown was as follows: 2,134 freight steamers, 631 sailing vessels, 14,332 barges, and, 112 rafts.

The tonnage was 1,878,134, an increase in the number of vessels over 1878 of 1,337, and tonnage 250,000.

The Delaware Division of the Lehigh Canal has an outlet at Bristol, Pa. The number of vessels passing in and out of the river at this outlet during 1879 was 2,564 all kinds, and tonnage 667,246.

Eight steamboat companies use this portion of the river between Trenton and Philadelphia, employing twenty-two steamers and seventeen barges in the transportation of passengers and freight.

No statistics for the year just past have been received.

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, at 12 o'clock m. August 27, 1880, for dredging in Delaware River, near Bordentown, N. J.

Number.	Names of bidders.	Residence.	Price per cubic yard.	To commence.	To complete.	Remarks.
1	G. H. Ferris	Baltimore, Md	$0 45	Spring of 1881.	Oct. 1, 1881	
2	Michael Herron	Bordentown, N. J.	22	Sept. 1, 1881	May 30, 1881.	Lowest bidder.

Abstract of contract entered into by Col. J. N. Macomb, Corps of Engineers, during the fiscal year ending June 30, 1881, for improvement of Delaware River, near Bordentown, N. J.

Name of contractor.	Residence.	Dredging.	Date of contract.	Remarks.
		Per cu. yd.		
Michael Herron	Bordentown, N. J	$0 22	Sept. 1, 1880	Completed May 30, 1881.

F 2.

IMPROVEMENT OF DELAWARE RIVER BELOW BRIDESBURG, PENNSYLVANIA.

The points at or near which obstructions to the free navigation of the Delaware River, below Bridesburg, now exist may be summarized as follows:

1. Five-Mile Point, between Bridesburg and Philadelphia.
2. Between Petty's Island and Philadelphia.
3. Smith's Island Bar, between Philadelphia and Camden.
4. A shoal in mid-channel, near Greenwich, Philadelphia.
5. The Horseshoe, between Philadelphia and the League Island Navy Yard.

These five localities may be considered as lying within the harbor of Philadelphia proper.

6. Mifflin Bar, 3 or 3½ miles below League Island.
7. Schooner Ledge, between Chester and Marcus Hook.
8. Cherry Island Flats, opposite Wilmington, Del.
9. Bulkhead Shoals, above Pea Patch Island, upon which Fort Delaware is built.
10. Dan Baker Shoals, half way between Philadelphia and the sea.

Below these shoals which are usually considered as lying at the head of Delaware Bay, there are other shoals with a draught of water over them insufficient for the present requirements of commerce.

The river and harbor act of June 14, 1880, made special appropriations for Schooner Ledge and Cherry Island Flats (which are therefore elsewhere reported upon in detail), and appropriated $85,000 for the general improvement of the Delaware, allotting, however, $40,000 for operations near Petty's Island, and $10,000 for Smith's Island Bar. These allotments left a balance of $35,000 only, for the remaining points.

It was impossible with this limited amount to do more than continue operations where they had been in progress at the most important points.

The reports in detail for each locality are as follows:

FIVE-MILE POINT.

The deep-water channel lying along the Philadelphia front, terminates below Five-Mile Point, and is separated by a bar from the deep water which exists opposite Bridesburg, and extends down towards the east, or New Jersey side of Petty's Island. A narrow curved channel with a low-water depth of 6 feet only, connects the two close under Five-Mile Point, and the up-river navigation, consisting of numerous passenger steamboats and heavy tows of canal barges en route to and from the two canals debouching into the Delaware at Bristol and Bordentown, is greatly inconvenienced by the frequent injury and delay due to grounding.

During the past year, for the relief of this traffic, the channel across the bar was dredged to 9 feet at low-water, with a width of 75 feet, over a distance of about 700 feet, at an expense of $2,500. This was regarded as a temporary expedient only, and no degree of permanence was anticipated. In fact, by the end of the fiscal year the channel had again shoaled to within a foot of its original depth. It may be assumed that no further expenditure at this point would be judicious, unless the amount to be expended be large enough to effect a radical alteration in the regimen of the river.

Fortunately the latest charts have shown the existence of a narrow but straight up-river channel, close under the upper end of Petty's Island, through which the river currents run true. It seems probable that this channel is due in some measure to the building up of the point of the island by dredging contractors as a dumping-ground, and that the deepening and widening of it by dredging would be permanent.

It is proposed to effect this during the ensuing season.

BETWEEN PETTY'S ISLAND AND PHILADELPHIA.

The construction of the artificial channel through the bar in this vicinity that separated the deep water lying off the upper part of Philadelphia from the main channel below, was begun in 1879, and, under one temporary and two regular contracts, has continued until the present time.

As reported last year, the channel on July 19, 1880, had a width of 100 feet, 24 feet deep at mean low-water.

With the $40,000 allotment of river and harbor act of June 14, 1880, further contract was made in August, and by June 30, 1881, the 24-feet channel had been widened 125 feet, giving it a total width of 225 feet. The current contract will be completed in August, and a new one will be thereafter made for continuing the widening.

The business of this portion of the harbor, due to the Reading shipments, and the large grain elevator recently put in operation, is, as shown by the commercial statistics, rapidly increasing in extent and value. Accommodation for this business can only be effected by a considerable increase of channel width, for which liberal expenditures will be required.

BAR BETWEEN PHILADELPHIA AND CAMDEN.

From both ends of Smith's Island bars extend up and down stream to the great inconvenience of vessels passing from one side of the island to the other, and particularly of the passenger traffic between the two cities.

The up-river bar in especial has a great development and nearly unites with one coming down from the lower end of Petty's Island. An allotment of $10,000 was made in the river and harbor act of 1880, out of the general appropriation for the river. In view of the doubts that were felt as to the permanency of any channel dredged through this bar, careful examination was made, resulting in the recommendation that with a portion of the appropriation a channel should be opened to a depth of 9 feet in a direction as nearly as possible in the line of flow from Cooper's Point, Camden, toward Shackamaxon street, Philadelphia.

Between September 13 and September 30, 1880, 10,000 yards were dredged, resulting in a channel 10 feet deep and 200 feet wide.

The work was executed as rapidly as possible and with unexpectedly favorable results. The flow of the currents appeared competent to maintain, and even slightly to deepen, the channel, and suggested an anticipation that the channel east of Smith's Island might become the route for many of the vessels drawing 12 and 15 feet that now throng the narrow main passage between Smith's Island and Philadelphia.

It is proposed during the ensuing season to expend the balance of the appropriation of June, 1880, in widening this channel to 400 feet.

SHOAL NEAR GREENWICH.

As reported last year, this shoal has 16 or 18 feet only over it at low-water, and should undoubtedly be removed as soon as the funds can be provided.

The estimated amount of dredging required above the 24 feet mean low-water place is 250,000 cubic yards, which will cost about $75,000.

THE HORSESHOE.

This portion of the river is so named from its peculiar topography. It constitutes the lower part of the harbor proper of Philadelphia, and while the curved form of the channel, is, to a certain extent, disadvantageous the channel depths are ample for all present requirements.

The lighting of the course by means of two sets of light-houses, now constructing, will obviate most of the summer difficulties. The serious ones are developed during the winter season.

The Horseshoe may be said to begin at Gloucester and terminate at Eagle Point. Between, the river widens to double its dimensions, with broad shallows in the concavity on the New Jersey side, and the Horseshoe shoals extending out from the convex shore.

The ice fills this enlargement, lodging on the flats and becoming fixed in position, while the channel is choked with floating masses that accumulate until gorged, and movement ceases until a change of tide partly relieves the pressure. The city ice-boats are frequently, though not always, successful in loosening the jam sufficiently to get vessels through.

An incidental disadvantage in this locality is caused by the opening back of League Island, by means of which a certain loss of flow in the Delaware occurs, injurious both to the Delaware and to the maintenance of the channel depths in the Schuylkill, near the mouth of which the lower end of Back Channel discharges.

Suitable means should be found both to correct the difficulties of the winter navigation of the Horseshoe and those due to the flow through Back Channel.

The subject has been heretofore investigated, but owing to the considerable expense involved in any adequate measures and the greater pressure for expenditures at other points, no decisive steps have ever been taken.

Further report will hereafter be made.

MIFFLIN BAR.

This obstruction is the first common to all vessels trading to this port, and consists of an up and down stream bar separating two deep channels.

An artificial channel having a diagonal direction across the bar was begun in 1873, and dredging has progressed yearly since. The original depth at low-water was 17 feet.

The Annual Report of the Chief of Engineers, 1879, page 426, shows that at that time a channel 26 feet deep at mean low-water existed, after vigorous operations by two powerful dredges.

The report for 1880 indicates a reduction in depth to 24 feet, notwithstanding that dredging was continued, the reduction in draught being due to the fact that but one dredge was employed, and that of a character not suited to such deep work.

During the past year the work has been still less satisfactory. Contract was made in October, 1880, with $25,000 of the $85,000 of the appropriation of June 14, 1880. A small amount of work was done in November and early December, when the ice compelled the withdrawal of the plant. Instead of resuming operations early in the spring, the contractor was backward in providing a suitable dumping place for the dredgings, and in consequence did not begin until May. By the 30th June, 13,252 cubic yards only had been dredged.

The consequence of this inefficient execution is that at the close of the fiscal year the low-water depth of the channel has decreased to 22 feet, which is entirely inadequate to the requirements of the Delaware traffic. The contract was to have terminated on June 30, but the time was extended to September 30.

The improvement of Mifflin Bar has some features not shared by any other locality now under treatment, except possibly the channel through Cherry Island Flats.

Experience has demonstrated that, in order to counteract the filling due to natural causes, an annual expenditure is required for dredging, and it is possible that in time the successive yearly removal of deposits would at length establish a satisfactory regimen. The amount of dredging required, however, would be immense. There is reason to believe that this amount could be largely reduced by such rapid and energetic work as would suffice to compel the tidal currents to aid rather than oppose.

The construction of permanent works in the alluvial bed of a tidal stream of the dimensions of the Delaware would involve a great cost, and should be postponed until clearly proven to be necessary.

It is proposed during the ensuing fiscal year to expend $45,000 of the appropriation of March 3, 1881, in dredging to a depth of 26 feet at mean low-water, and by rapid work to ascertain what width of channel of that depth can be secured, and observe the resulting action of the tides.

SCHOONER LEDGE AND CHERRY ISLAND FLATS,

respectively 18 and 27 miles below Philadelphia, are obstructions whose removal is of great importance. Each has its distinct appropriation and separate report.

BULKHEAD SHOALS.

With the increased dimensions of shipping and the improvements in progress at other points, these shoals are becoming a more serious obstruction every year.

The channel is now 22 feet in depth and narrow, and vessels are constantly grounding, or compelled to anchor above and below to await the rise of tide. A considerable expenditure will be required to deepen and widen the channel in the vicinity of the Deep-Water Point Ranges. Being a flood-tide channel, the obstructions are found near the upper end, and it is probable with the removal of the wrecks lying in the vicinity that the depth of 24 or 25 feet can, with a few years' work, be made permanent.

In consequence of the lack of sufficient funds to accomplish any valuable results, no expenditures were made upon these shoals during the past year, although an allotment of $8,000 or $10,000 was reserved therefor out of $85,000 appropriated in June, 1880. With this balance, and a further sum of $32,000 out of the $100,000 appropriated March 3, 1881, contract will be made during the ensuing season for dredging a 24-foot channel to as great a width as the funds available will admit.

DAN BAKER SHOALS.

These shoals lie across the expansion of Delaware River, below Reedy Island, and are probably due in part to this spreading of the shores, and in part to the change of direction in the course of the stream.

As in the case of Bulkhead Shoals, two sets of range lights are required to mark the course.

The channel depths are 22 and 23 feet, and while hitherto no expenditures have been made in this locality by reason of the insufficient appropriations and the urgency at other points, the pressure for a modification of the difficulties encountered is steadily increasing. The chart from a recent survey shows that in order to connect the 24-foot curves above and below the shoals dredging will be required for a distance of about 1,800 yards with an average depth of cut of about 1 yard. In order to meet the requirements of navigation, the channel width should not be less that 300 yards. The material to be removed is sand and mud, and since the excavation would be made along the natural channel, that is, the line of present deepest water, it is not believed that any extraordinary tendency to fill would be developed by the deepening.

The improvement might therefore be expected to prove at least semipermanent in its character.

PROPOSED APPLICATION OF THE $100,000 APPROPRIATED IN ACT OF MARCH 3, 1881, FOR DELAWARE RIVER BELOW BRIDESBURG.

Continuing operations at Mifflin Bar	$45,000
Begin operations at Bulkhead Shoals	32,000
Continuing operations at Petty's Island Bar	20,000
Constructing new up-river channel past head of Petty's Island	3,000
Total	100,000

WRECKS.

The complete removal of wrecks within as brief a period as possible after their occurrence will always be an important feature of river and harbor improvements.

Besides being dangerous obstructions themselves, the interference with the regular flow of the currents due to their presence in the easily abraded bed of an alluvial tidal stream like the Delaware, which has velocities of 2 and 2½ miles per hour, is liable to cause immediate changes of channel and the formation of shoals that rapidly become formidable in dimensions and consequent cost of removal.

Up to June, 1880, there was no general legislation authorizing the executive officers of the United States to remove these wrecks, and the accompaning list, furnished by Mr. C. K. Ross, master warden of this port, shows the result of this inaction.

Section 4 of the river and harbor act of June 14, 1880, marks the intention of Congress to provide generally for the removal of all wrecks prejudicial to the navigation of the navigable waters of the United States, and is an invaluable step in the right direction. Some difficulty may, however, be encountered in carrying out the provisions of the act. It may prove that the failure to mention a specific sum to be drawn against by the Secretary of War for the removal of wrecks is a defect in the law, and the condition that the vessel and cargo shall be sold to the highest bidder *after removal* is clearly disadvantageous to the United States.

If the wreck and cargo are worth more than the cost of removal, the owners or underwriters may generally be relied upon to effect it. The wrecks remaining to be removed by the United States will not usually repay this cost. Contract having been made for removal, the value of material *landed* will in a great measure depend upon the care and means employed.

The divers who do such work will expedite their own labor by performing it by the readiest method, irrespective of resulting values, and their operations cannot be easily supervised.

If the executive officers charged with the removal of these derelicts were authorized to use the existing values in the wrecks, to reduce the cost of removal, by surrendering the wreck and cargo to the contractors at the time of making contract, an important economy would be attained, since the wreckers would have an interest in conserving as much value as possible, and could therefore offer more for it *in situ* than any one else, either then or later. The value of the wreck and cargo could then be made a direct offset to the cost of removal with resulting economy and simplicity of account. It is assumed that the officer charged with the duty shall have informed himself as fully as possible of the condition, cargo, &c., of the wreck.

In order to cover this point as well as to meet the objection to an "indefinite" appropriation, I respectfully recommend, 1st, an appropriation of $5,000 "for the removal of wrecks in Delaware Bay and River," to be used in getting rid of the more formidable obstructions now existing or that may hereafter occur, and, 2d, that the slight modification be made in the existing law of June 14, 1880, necessary to allow of the values in wreck and cargo (when declared derelict after due notice to owners) being used as an offset to the cost of removal *at the time of making contract*.

In other words, that the vessels and contents may be sold to the wreckers, who nine times out of ten will bid more for them than any one can after removal. The existing law covers the tenth case.

The appended list of wrecks is not necessarily complete, the information having been collected by Mr. Ross in the only method now practicable, viz, from the pilots. The names of both vessels and owners are in many cases wanting.

ICE HARBORS.

The manifest necessity for the protection of the commerce of the Delaware by the construction of ice harbors at suitable points for the shelter of vessels is an accepted proposition having the sanction of Congress by repeated legislation.

The following quotation is made from Captain Ludlow's report of January 24, 1880:

> In average years there are about three months, viz, between December 15 and March 15, during which more or less ice is running in the Delaware. This ice moves up and down stream with the tides and from side to side of the channel, according to the direction and velocity of the wind, and at times from repeated packing may become heavy enough to crush in the bows of a large iron steamer, if they be not sufficiently protected against it. At other times the ice may be only an inch or so in thickness, but in either condition is dangerous to shipping, and especially to wooden vessels, the thin ice, from its sharp, cutting action at the water-line, being frequently rather more so than the heavier floes.

The past winter exhibited some abnormal phenomena for this latitude, freezing taking place at an extraordinarily early day, and with prolonged periods of steady cold weather, lasting until late in the spring.

At one time, and for several days, the entire surface of the river and bay, and as far seaward as the eye could reach, was covered with an unbroken sheet of ice. Fortunately such winters do not occur twice in a century. Again, an open winter occurs, such as that of 1879–'80, when scarcely any ice formed. It is, however, the average condition at least that must be provided for, and it may be assumed, for this purpose, that during three months the safety of the Delaware navigation requires the protection of ice harbors.

The two principal existing ones are at New Castle and Marcus Hook, the former inclosing about 6 acres and the latter recently increased from 4 to 8 acres by the construction of two additional piers.

The Chester Harbor is small and incapable of enlargement, and the Reedy Island Harbor has completely gone to decay.

The restoration of the Reedy Island Harbor, or rather its reconstruction about 6 or 7 miles further down, is to-day most urgently demanded by the navigation interest. Vessels entering from sea are apt to encounter heavy fresh-water ice, discharged by the river, while those on the outward journey, having come down from New Castle with one tide, should be able safely to await a favorable wind and tide for going to sea. It is understood that in the absence of a suitable harbor, vessels must either resort to the dangerous and often futile expedient of anchoring in the moving ice, or submit to drifting with it, thereby losing the distance gained and running the risk of grounding.

The two harbors at New Castle and Marcus Hook are so essential to the moving traffic of the river and are so crowded with vessels at certain times as to call for protection, against a yearly increasing evil, which is stated in the report by Colonel Ludlow, previously referred to, as follows:

> The pre-emption of these costly structures, intended to protect vessels pursuing their voyages and caught in the ice, by other vessels that occupy them during the winter merely as a lying-up place, is an abuse that has increased until the utility of the harbors to the interests intended to be benefited has been largely reduced.

And the recommendation was made that a harbor-master should be appointed by the United States to exercise control over all vessels entering the harbor.

It is desired to renew and emphasize this recommendation. No doubt exists as to the desirability of an efficient supervision of these harbors for at least three months in the year. The only question is as to the means.

Both Marcus Hook and New Castle are places of small population, and the appointment of a harbor-master by the local authorities, even were it desirable to transfer the duty to them, would fail to carry with it the requisite weight to enforce necessary measures. In order to a thorough discharge of his duties, the harbor-master should be a United States officer; and since neither of these harbors is yet completed, and both are therefore in charge of the Engineer Department, United States Army, it is strongly recommended that by suitable legislation Congress should authorize the temporary appointment, by the engineer officer in charge of the river and harbor improvements, of harbor-masters, who shall receive their instructions from the United States Engineer office, and be empowered to compel a vessel either to change her position or to leave the harbor, as he may direct.

Entirely suitable and capable persons for this duty can be engaged at $3.50 per day for the period of employment, which should continue during the ice season.

DISPOSAL OF DREDGINGS.

The system inaugurated in 1879, of providing in all dredging contracts that the materials dredged shall be removed from the tidal limits of the river, either by landing them above high-water or confining them by a permanent dike or bulkhead, has since been pursued, with marked benefit to the navigation.

The material, which was formerly dredged at one point and wasted by dumping it at another, is now taken entirely out of the stream and used in filling up lowlands, or otherwise usefully disposed of.

Furthermore, the serious injury to navigation caused by the indiscriminate dumping of dredgings to the annual amount of millions of cubic yards, both in deep channels and where too little depth already existed, has been checked, and the local authorities have been enabled to promote a wholesome respect for existing salutary laws. While infractions of these laws have occurred, their open violation has ceased and is no longer justified by public opinion.

The cost of the work as now performed is not much, if any, greater than formerly, but the price of dredgings is a function of many variables and cannot be clearly solved for one. A comparison of existing prices with those of former years shows that they are both less and greater.

As might be anticipated, the contractors adapt their methods to the altered circumstances, and make a profit by filling lowlands, either their own or otherwise, that under competition reduces the actual cost of dredging to nearly or quite the old figures.

The economy resulting from the fact that a great source of injury to the navigation has been cut off, and that the materials now dredged will not hereafter have to be rehandled, is beyond computation.

SURVEY OF DELAWARE RIVER.

The act of June 14, 1880, directed a continuance of the survey of Delaware River which was begun in 1878.

For the purposes of the survey the limit of the river was assumed to be in the vicinity of Liston's, where engineering constructions have been proposed, and which is usually regarded as the head of the bay.

The Annual Report of the Chief of Engineers, 1879, pages 485–6, gives the progress of the work to June 30, 1879.

In the absence of any special appropriation, and with funds derived from the amount allotted in the survey section of the act of 1880, the work has been continued the past year until the river has now been completely surveyed from League Island to below Liston's Point, and charts are in course of preparation on a scale of 800 feet to the inch, which will be hereafter submitted. The sextant was freely used in this work not only from the surveying launch for the hydrography, but for a rapid sketching in of the shore lines between the trigonometrical stations.

In addition to the surveys specially ordered, frequent examinations have been made of the various localities under improvement. As a rule, a survey is made in the spring preliminary to resumption of work, occasionally again as the work progresses, and in the fall before the close of navigation. In the case of a work completed during the season, the results are ascertained before final payment. The successive charts constitute a practical history of each work essential to a proper understanding of its local features and special peculiarities.

In order to complete the survey and chart of the tidal section of the Delaware, an appropriation of $3,000 is recommended for continuing the survey from Philadelphia toward Trenton.

GENERAL REMARKS AND RECOMMENDATIONS.

The task of regulating a stream of the dimensions of the Delaware must be regarded as a formidable one, whether from the point of view of time or cost. In order to attain a continuous low-water navigation of 25 or 26 feet from Philadelphia to the sea, large annual expenditures will be required for many years to come, and the greater portion of these will probably be needed for the dredging operations necessary for the removal of shoals and silt from the bed of the stream. In addition to the Delaware itself, an amount of dredging, perhaps half as great, will be demanded for the improvement of its numerous affluents.

Under these circumstances, any practicable reduction of the cost of dredging is of great importance, both to the navigation and to the United States Treasury.

The contract system generally in force for this work has some serious defects.

The appliances owned by the contractors have not as a rule been radically improved for many years. The requirements of their business are such that they must be ready to take any sort of work at short notice. The dredging plant is, therefore, not perfectly adapted to any one kind of work, and in the majority of cases is not capable of economical or scientific work at all. The English and Canadian authorities get their dredging done at stated cost, averaging about one-half those paid for similar work in this country. It follows that either the American contractors make immense profits (which is certainly not the case), or that the average dredge is an unscientific and costly machine. As a matter of fact, regarded as pieces of machinery adapted to a special purpose, they are as a rule extremely defective.

So far as the government work is concerned, the remedy is obvious. In any stream where it is certain that large amounts of dredging will be annually required, the United States should build their own plant upon the most approved plans and use the most recently perfected appliances. In the Delaware there will be full employment for at least three powerful dredges, with the necessary scows and other appliances. The advantages of the possession by the United States of an efficient dredging plant would be several.

The cost of dredging would be greatly reduced, and the ultimate effectiveness of the appropriations for river and harbor works would be correspondingly augmented.

When rapid and thorough execution is required, such as that on Mifflin Bar, the government dredges could be trusted to do the work, when few contractors could be found with proper plant.

At such times as an emergency called for the immediate use of a dredge, it could be had without loss of time.

The cost of many of the smaller dredging works would be reduced one-half or even two-thirds. For the larger works competition tends to keep down prices. The smaller ones fall to those having unemployed dredges in the vicinity at prices frequently two or three times greater than the real cost of the work.

The appropriations in the river and harbor acts for improvements, being usually less than are needed for the execution of the work itself, allow no margin for the accumulation of plant by the government, and special authority and provision are therefore required. I respectfully recommend that a beginning be made during the ensuing year by means of a special appropriation of $75,000, independent of the amounts of appropriations for particular streams, for the construction, under plans to be prepared in this office, of one improved dredge and three scows, for general use in this district, wherever they may be useful.

It should be understood that even were three dredges owned by the government, there would still be full occupation for all serviceable plant owned by contractors.

Another point to which it is desired to invite attention is the probability that in the near future some action may be necessary looking to a certain regulation or supervision of shore structures on the banks of streams under improvement by the United States.

State laws generally concede to riparian owners the right to build to low-water mark without interference. Under these laws, and with extensions beyond low-water authorized by the local authorities, structures have been built whose effects are manifestly injurious to navigation, and will continue until their removal.

It often escapes observation that a shore structure extending into the stream so as to interfere with the flow of the currents may be as detrimental both in the present and future as though it had been built in the middle of the stream.

Some general legislation will be needed to correct existing and possible encroachments of this character.

ESTIMATE FOR 1882–'83.

For the continuance of the works now in progress, there will be required during the fiscal year ending June 30, 1883, not less than $150,000.

This estimate makes no allowance for beginning operations on Dan Baker Shoals. Should such allowance be made, the estimate would be increased by $50,000.

SUMMARY OF AMOUNTS RECOMMENDED FOR APPROPRIATIONS IN THIS REPORT.

Improving Delaware River below Bridesburg, Pa	$150,000 00
Beginning operations on Dan Baker Shoals	50,000 00
Removal of wrecks in Delaware Bay and River	5,000 00
Continuing survey from Philadelphia to Trenton	3,000 00
Construction of one improved dredge and appliances	75,000 00
Total	283,000 00

The total appropriations for the improvement of this river to June 30, 1881, are $535,000.

Money statement.

July 1, 1880, amount available	$88,525 31	
Amount appropriated by act approved March 3, 1881	100,000 00	
		$188,525 31
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	43,403 54	
July 1, 1881, outstanding liabilities	2,883 99	
		46,287 53
July 1, 1881, amount available		142,237 78
Amount that can be profitably expended in fiscal year ending June 30, 1883, for the Delaware River		150,000 00
Ditto, for special purposes above enumerated		133,000 00
Total		283,000 00

LIST OF VESSELS SUNK IN DELAWARE BAY AND RIVER.

Brig, on Duck Creek Flats. (Buoyed.) Sunk about five years. Owned by Ayres & Prescott.

Two schooners, about 3 or 4 miles above New Castle. (Buoyed.) Sunk in 1879.

Schooner Chas. Devins, about three-fourth of a mile below the Buoy of the Middle, in the channel. (Buoyed.)

Schooner, close to the turn buoy in the Pea Patch, Bight of New Castle. (Buoyed.) Sunk in 1879.

Schooner, below Morris Liston's, upper part of Duck Creek Flats. (Buoyed.)

United States steamer Ironsides, lower inward part Horse Shoe.

Oyster boat, about 1 mile above New Castle, in the channel, in about 4 fathoms water. (No buoy.)

Oyster boat, above Reedy Island, in the channel, in about 5 fathoms water. (No buoy.)

Schooner, one-quarter mile below light-ship, 14-foot bank. (Buoyed.)

Schooner, 1 mile northeast of flats (Miah-Maul), sunk August 24, 1880. Owned in Lewiston, Del.

Schooner, upper end of Bombay Hook Woods.

Three-masted schooner, below channel buoy, a little to the westward below New Castle. (Channel buoy.) Sunk about two years.

Four canal-boats, a little below Christian street wharf.

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, at 12 *o'clock m., August* 17, 1880, *for dredging in Delaware River near Petty's Island.*

No.	Names of bidders.	Residence.	Price per cubic yard.	Time of commencing.	Time of completing.	Remarks.
1	G. H. Ferris.......	Baltimore, Md ...	$0 49	When notified that bid is accepted.	Dec. 1, 1881	
2	Frank Pidgeon, jr.	New York City..	51	In 60 days	Nov. 1, 1881	
3	American Dredging Company.	Philadelphia, Pa.	46	Oct. 1, 1880....	Oct. 1, 1881	Lowest bidder.

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, at 12 *o'clock m., August* 28, 1880, *for dredging in Delaware River between Camden, N. J., and Philadelphia, Pa.*

No.	Names of bidders.	Residence.	Price per cubic yard.	To commence.	To complete.	Remarks.
1	G. H. Ferris.........	Baltimore, Md ..	$0 44$\frac{3}{4}$	Sept. 1, 1880	Dec. 1, 1880	
2	American Dredging Company.	Philadelphia, Pa.	39	At once.......	Remove about 1,000 yards per day.	Lowest bidder

Abstract of informal proposals received by Col. J. N. Macomb, Corps of Engineers, in response to a circular letter of September 9, 1880, *inviting same for dredging at Five-Mile Point, Delaware River.*

No.	Names of bidders.	Residence.	Dredging.	Remarks.
			Per cu. yd.	
1	American Dredging Company............	Philadelphia, Pa......	$0 46	
2	G. H. Ferris............................	Baltimore, Md..........	42	
3	Frank Pidgeon, jr........................	New York City	38$\frac{9}{16}$	Lowest bidder.

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, at 12 *o'clock m., October* 11, 1880, *for dredging in Delaware River at Mifflin Bar.*

No.	Names of bidders.	Residence.	Dredging.		Remarks.
			Contractor to use his own plant and secure his own place of deposit.	Contractor to use government plant and deposit on government lands.	
			Per cu. yd.	*Per cu. yd.*	
1	National Dredging Company.	Washington, D. C.	$0 37½	$0 34	Provided that they are awarded the contract for Schuylkill River.
2	American Dredging Company.	Philadelphia, Pa..	43	41	Provided that they have the exclusive use of the government plant.
3	Frank Pidgeon, jr........	New York. N. Y..	33	38	Lowest bidder.

Abstract of contracts entered into by Col. J. N. Macomb, Corps of Engineers, during the fiscal year ending June 30, 1881, *for improvement of Delaware River below Bridesburg, Pa.*

Names of contractors.	Residence.	Locality.	Dredging.	Date of contract.	Remarks.
			Per cu. yd.	1880.	
Amerian Dredging Company.	Philadelphia, Pa.	Near Petty's Island.	$0 46	Aug. 26	
Do..............	....do...........	Smith's Island......	39	Sept. 6	Completed September 30, 1880.
Frank Pidgeon, jr...	New York, City.	Five-Mile Point	38$\frac{9}{10}$	Sept. 18	Completed.
Do..............	....do...........	Mifflin Bar..........	33	Oct. 25	

COMMERCIAL STATISTICS.

[Taken from the books of the Maritime Exchange, Philadelphia, from January 1 to December 31, 1880.]

American vessels entered from foreign ports:

Vessels (cargo)	474
Tons (cargo)	282,362
Vessels (ballast)	10
Tons (ballast)	8,744

American vessels cleared for foreign ports:

Vessels (cargo)	313
Tons (cargo)	228,428
Vessels (ballast)	34
Tons (ballast)	10,534

Foreign vessels entered from foreign ports:

Vessels (cargo)	1,059
Tons (cargo)	882,611
Vessels (ballast)	170
Tons (ballast)	119,443

Foreign vessels cleared for foreign ports:

Vessels (cargo)	1,136
Tons (cargo)	899,996
Vessels (ballast)	22
Tons (ballast)	10,579

Number of coastwise arrivals:

Steamers	1,872
Ships	7
Barks	50
Brigs	44
Schooners	4,152

Number of coastwise clearances:

Steamers	1,846
Ships	19
Barks	54
Brigs	49
Schooners	3,393

Exports of grain and petroleum from the port of Philadelphia from 1870 *to* 1880, *inclusive.*

	Grain.	Oil.
	Bushels.	*Barrels.*
1870		1,101,636
1871	2,797,946	1,256,866
1872	3,665,763	1,221,252
1873	3,691,035	1,891,764
1874	5,241,365	1,572,242
1875	7,631,916	1,367,574
1876	20,839,420	1,398,935
1877	12,888,269	986,799
1878	28,684,487	1,503,833
1879	31,387,851	1,726,118
1880	27,892,234	1,084,682

Shipments of anthracite coal from Port Richmond by the Philadelphia and Reading Railroad Company, from 1870 *to* 1880, *inclusive.*

	Tons.		Tons.
1870	1,951,467	1876	1,832,627
1871	2,343,025	1877	2,784,657
1872	2,238,850	1878	2,136,215
1873	2,226,865	1879	2,618,309
1874	2,051,127	1880	1,631,603
1875	1,703,459		

Exports to foreign countries from the port of Philadelphia during 1880.

Bacon and hams	$4,800,872
Beef, salt	222,909
Beef, fresh	576,718
Boards, lumber, bark, &c	715,733
Books	30,928
Butter	94,978
Cars, carriages, &c	71,582
Chemicals and drugs	74,581
Cheese	23,526
Coal	208,237
Corn	9,951,936
Corn meal	56,356
Cotton	2,883,830
Fruits and vegetables	64,937
Furs and fur-skins	109,454
Iron and iron manufactures	483,330
Lard	1,017,273
Lard oil	25,002
Leather and leather manufactures	434,350
Hides and skins	9,650
Live stock	221,207
Miscellaneous articles	321,644
Miscellaneous breadstuffs	696,769
Miscellaneous manufactures	627,424
Molasses	138,836

Naphtha	$88, 936
Oats	16, 492
Oil-cake	378, 967
Petroleum (crude)	316, 330
Petroleum (refined)	4, 640, 459
Other oils	41, 940
Residuum	16, 034
Rye	5, 600
Sugar	4, 486
Tallow	554, 298
Tobacco, leaf	837, 070
Wheat	14, 548, 054
Wheat flour	1, 478, 856
	46, 589, 584

RECAPITULATION.

Statement of the value of exports to the following foreign countries from Philadelphia for year ending December 31, 1880.

Countries.	American vessels.	Foreign vessels.	Total value.
Austria		$127, 016	$127, 016
Belgium		4, 291, 460	4, 291, 460
Brazil	$44, 985	43, 033	88, 018
China		5, 012	5, 012
Denmark		679, 314	679, 314
Danish West Indies	4, 904		4, 904
France	138, 864	6, 557, 601	6, 696, 465
French West Indies	67, 593	50, 269	117, 862
French Possessions in Africa		7, 125	7, 125
Germany	41, 857	2, 031, 547	2, 073, 404
England	5, 547, 553	13, 899, 817	19, 447, 370
Scotland	21, 298	238, 613	259, 911
Ireland	222, 414	5, 114, 757	5, 337, 171
Gibraltar	37, 175	718, 985	756, 160
Nova Scotia and New Brunswick	10, 125	32, 312	42, 437
Quebec		3, 718	3, 718
British West Indies	199, 575	242, 327	441, 902
British Guiana	76, 832	5, 080	81, 912
British Honduras	2 156		2, 156
British Possessions in Australasia	162, 728		162, 728
Hayti		6, 188	6, 188
Italy		901, 760	901, 760
Japan	118, 258	47, 229	165, 487
Mexico	134, 363	729	135, 092
Netherlands	17, 421	1, 598, 184	1, 615, 605
Danish West Indies :	5, 654	2, 424	8, 078
Portugal	223, 670	1, 691, 181	1, 914, 851
Russia on the Baltic		24, 734	24, 734
San Domingo	2, 284		2, 284
Spain		246, 343	246, 343
Cuba	580, 229	133, 555	713, 784
Porto Rico	2, 793	9, 222	12, 015
Sweden		87, 272	87, 272
Norway		65, 179	65, 179
Turkey in Africa		27, 528	27, 528
United States of Colombia		9, 717	9, 717
Venezuela	24, 829	2, 793	27, 622
Totals	7, 687, 560	38, 902, 024	46, 589, 584
Total exports during the year 1879			50, 685, 838
Decrease in 1880			4, 096, 254

Foreign imports during 1880.

Bark	$621, 805
Books	152, 951
Coffee and spices	91, 680
Drugs, chemicals, and dyestuffs	2, 462, 753
Earthenware and stoneware	631, 053
Fish and provisions	44, 475
Grass and seeds	89, 544

Hair and skins	$540, 498
India-rubber (crude)	523, 247
Iron and hardware	8, 602, 144
Jewelry and precious stones	395, 348
Kryolite	93, 662
Marble	80, 762
Metal and manufactures	695, 447
Mineral and mineral substances	571, 130
Miscellaneous articles	1, 936, 090
Miscellaneous manufactures	6, 239, 252
Molasses	3, 221, 635
Oils, paints, and glassware	287, 266
Paper material	257, 332
Salt	252, 604
Sugar	5, 464, 677
Tin	2, 565, 679
Vegetables and fruit	1, 576, 195
Wines and liquors	303, 787
Wool	1, 232, 816
	38, 933, 832

RECAPITULATION.

Statement of the value of goods imported direct from foreign countries to port of Philadelphia for the year ending December 31, 1880.

Countries.	In American vessels.	In foreign vessels.	Totals 1880.	Totals 1879.
Azores		$17, 303	$17, 303	
Belgium		2, 165, 498	2, 165, 498	$1, 179, 986
Brazil	$256, 987	102, 657	359, 644	1, 350, 300
Cape Colony				25
Central America				523
Chili		106, 571	106, 571	45, 611
Cuba	5, 731, 100	1, 857, 723	7, 588, 823	7, 296, 003
Denmark		7, 268	7, 268	46, 298
Danish West Indies				108
Dutch West Indies	22, 294	7, 688	29, 982	
England	8, 368, 976	12, 752, 465	21, 121, 441	13, 964, 080
British Possessions in Africa		420	420	
British East Indies		4, 525	4, 525	95, 380
British West Indies	274, 666	189, 702	464, 368	302, 321
British Guinea		24, 289	24, 289	
British Possessions, all other		2, 925	2, 925	
France	3, 444	449, 906	453, 350	77, 974
French West Indies	423, 480	494, 057	917, 537	380, 021
French Possessions in Africa		96, 499	96, 499	90, 668
Germany	31, 426	672, 125	703, 551	208, 999
Greenland	14, 854	78, 808	93, 662	70, 661
Greece		180, 598	180, 598	20, 354
Hayti	76, 421	31, 579	108, 000	93, 441
Ireland		25, 783	25, 783	62
Italy	74, 745	1, 200, 790	1, 275, 535	912, 369
Mexico	52, 063		52, 063	72, 183
Netherlands		225, 694	225, 694	66, 044
Nova Scotia	21 '739	14, 563	36, 302	50, 020
Ontario		660	660	
Peru				48, 540
Portugal	42, 175	234, 026	276, 201	80, 710
Porto Rico	25, 873	18, 361	44, 234	133, 540
Russia on the Baltic	30, 396	565, 517	595, 913	25, 713
Russia on the Black Sea		486, 203	486, 203	
Scotland	30, 581	158, 576	189, 157	
Spain	3, 216	688, 131	691, 347	348, 110
Sweden and Norway	359	462, 008	462, 367	73, 018
Turkey in Europe		16, 446	16, 446	
Turkey in Asia		31, 100	31, 100	14, 613
United States of Colombia		9, 635	9, 635	11, 601
Uruguay		4, 502	4, 502	
Venezuela	20, 372	44, 064	64, 436	156, 373
Totals for 1880	15, 505, 167	23, 428, 665	38, 933, 832	27, 224, 549
Totals for 1879	15, 500, 064	11, 724, 485	27, 224, 549	
Increase 1880 over 1879	5, 103	11, 704, 180	11, 709, 283	

Importations of sugar and molasses at the port of Philadelphia, 1879 *and* 1880.

SUGAR.

Years.	Barrels.	Hogsheads.	Boxes.	Baskets.	Tierces.	Bags.	New Orleans, hogsheads.
1879	....	93,012	1,010	446	....	3,316	6,109
1880	2,706	78,105	691	....	1,741	2,058	....

MOLASSES.

Years.	Hogsheads.	Tierces.	Barrels.
1879	99,003	9,929	186
1880	92,664	8,683	804

Value of the exports and imports at Philadelphia for the last ten years.

Years.	Exports.	Imports.
1871	$20,688,551	$20,820,374
1872	20,484,803	26,824,333
1873	29,683,186	29,186,925
1874	29,878,911	25,004,784
1875	31,836,727	24,011,014
1876	50,539,450	21,000,000
1877	37,823,356	20,126,032
1878	48,362,116	21,048,197
1879	50,685,838	27,224,549
1880	46,589,584	38,933,832

LETTER OF THE PHILADELPHIA AND READING RAILROAD COMPANY.

OFFICE OF THE PHILADELPHIA AND READING RAILROAD COMPANY,
227 South Fourth street, *Philadelphia, September* 5, 1881.

DEAR SIR: The tonnage of this company passed over its piers on the Upper Delaware front in 1880 was as follows:

	Tons.
Anthracite coal	1,711,134
General merchandise	864,826
Grain (13,597,000 bushels)	407,910

For this year the tonnage will certainly aggregate 3,400,000 tons, and our ability to increase our water traffic depends mainly upon our ability to float large ships to Port Richmond, where all our future development must be made.

As a matter of interest in showing you the development of tonnage, I beg to submit below the aggregate tonnage of each year as far back as 1874.

	Tons.
1874	2,236,878
1875	1,881,950
1876	2,030,482
1877	3,043,881
1878	2,533,856
1879	3,241,817
1880	2,983,870
Total for seven years	17,952,734

Yours, truly,

I. LOWRY BELL,
G. T. M.

Col. WILLIAM LUDLOW,
United States Engineer.

F 3.

IMPROVEMENT OF DELAWARE RIVER, AT SCHOONER LEDGE.

The original special report upon this ledge is given with chart, in the Annual Report, Chief of Engineers, 1879, and may be referred to as covering the argument for the necessity of the improvement.

The main channel for heavy vessels follows the western shore of the Delaware River from Marcus Hook to Chester, in a nearly straight course, with general depths of 25 to 30 feet. Opposite Marcus Hook the channel has a width of 700 or 800 yards between the 24 feet low-water contours, but, about 1 mile above there is a rocky shoal some 1,200 yards long, up and down stream, by 250 yards in width, with reduced depths of 20 to 22 feet over the greater portion.

This shoal lies in mid river, and separates it into two 24-foot channels, the eastern one having a width of 400 to 500 yards, and the western one 200 yards. The eastern channel is intercepted near its upper end by Chester Island Bar, and is moreover considerably curved, so as to be unsuitable for long vessels and for lighting or improvement.

The western channel is obstructed at the upper end by Schooner Ledge, lying directly in the channel, which originally left a narrow and dangerous passage between it and the west bank of less than 45 feet width between the 24-foot contours, with high projecting points close at hand, having but 18 and 19 feet of water over them.

By reason of the greater depth and directness, this was necessarily the main channel for deep draughts, and with the increased dimensions of ships the ledge became so serious an obstruction that vessels drawing 23 to 26 feet could with difficulty pass, except at high-water, and even then incurred great risk of striking.

This difficulty was enhanced by reason of the imperfection of the ranges used by the pilots in passing the ledge.

These ranges were two chimneys at Chester, which from their size and proximity were not delicate enough for so narrow and dangerous a passage, and furthermore, as generally used, brought a vessel too far to the westward of the best water, and exposed it to touching on the rocky bottom of the west shore. In the absence of better guides, they answered their purpose tolerably well, so long as the draughts were not too great.

In September, 1880, as the steamer Illinois was going to sea, drawing 22 feet of water, the ledge was passed in safety, but while running the pilot's range and at a point about 200 yards south of the main ledge, a hitherto unreported rock was struck. The extent of the damage to the steamer is stated by the agents to have exceeded $20,000, actual cost of repairs, in addition to loss of time, &c.

A survey of the rock ensued. It stood in 26 to 27 feet of water with about 20 feet of water over it at low-water.

At the 24-foot plane its base was less than 10 feet diameter, the main head 4 feet across either way by 4 feet high, with a ridge 2 feet by 1 foot by 3 feet high. The river bottom in the vicinity was rough, with projecting points above the 24-foot plane.

One of a line of soundings run in October and November, 1878, gave 27.7 feet close to the rock, without affording any indications of its existence, which, so far as can be ascertained, was entirely unknown to pilots or shipmasters.

It was supposed that the rock, from the steepness of its sides and comparatively small dimensions, offered a favorable opportunity for speedy removal by means of surface blasting.

Accordingly, on December 1, 1880, three charges of dynamite of 50 pounds each, judiciously placed, one on the back of the rock and one on either side at the foot, were simultaneously discharged at high-water, when the depth was about 32 feet.

A heavy column was projected to a height of 40 to 50 feet, but the effect upon the rock was disappointing. Although largely reduced in bulk, the summit was lowered only 0.7 foot. Owing to the severity of the season further operations were necessarily postponed.

On December 15, 1880, the improved channel past the ledge was aligned by the Light House Establishment, by two range-lights on the shore above Chester, giving a straight course thence to a point 160 yards outside the outer pier at Marcus Hook, and passing parallel to, and 23 yards west of, the present western border of the ledge. This channel is therefore now available for navigation by day and night, although the restricted width still demands careful steering and the closest attention to the superposition of the ranges.

Drilling and blasting operations were resumed as early in the spring as the late season and disappearance of the ice would admit, and attention was again given to the Illinois Rock.

The surface blasts having failed, the drill platform was placed over it on May 16, 1881, and six holes reaching 3 to 4 feet below grade (24 feet plane) were drilled, and charged with 35 pounds of explosive.

By the simultaneous discharge of these the rock was completely obliterated to 25 feet at mean low-water, and 14 cubic yards were subsequently hoisted by the diver.

In the course of the examination, another fixed rock was discovered, about 60 feet directly up stream, with about 25 square feet top surface, at 21.3 feet below mean low-water. This rock it is proposed to remove at an early day.

The whole channel in the vicinity of the ledge and along the range line must be thoroughly swept to insure the discovery of these small peaks, which are so exceedingly dangerous to shipping.

This work is now in progress, and the results will be hereafter reported.

Judging from the numerous fragments of copper sheathing collected by the diver, collisions with the peaks must have been frequent, and it is difficult under the circumstances to account for the entire reticence of pilots and masters with reference to these hidden dangers.

Every projecting point examined gives evidence of destruction. The dredge operating on the ledge, brought up the blade of an ocean propeller 8 feet in length.

The regular work on the ledge continued throughout the summer and fall of 1880, and into the winter until December 9, 1880. During that time 1,244 square yards of ledge surface were reduced to the 24-foot plane by drilling and blasting, while a still greater area was covered by the operations of a dredge, removing sand, gravel, and bowlders, and tearing up portions of solid reef.

The entire area worked over between November, 1879, and June, 1880, was about 6,733 square yards. Between the latter date and June 30, 1881, there have been removed from the ledge, of rock and bowlders, 476 cubic yards, and of gravel and sand 1,740 cubic yards.

The entire quantity removed since commencement of work in 1879 is—

	Cubic yards.
Of rock and bowlders	2,062
Of gravel, sand, &c	4,049
Making a total of	6,111

This quantity represents an average depth of excavation of 2.72 feet over the entire surface.

The expenditures aggregate to June 30, 1881, $51,787.69, and therefore indicate a cost of $7.69 per square yard of ledge surface worked over, $25.11 per cubic yard of rock and bowlders removed, and $8.47 per cubic yard for the average of all material.

The result of these operations to date has been the widening, by means of a succession of straight cuts along the west side of the ledge, of the 24-foot mean low-water channel from 45 to 150 feet.

The bed-rock of the ledge, as stated in the original report, is a stratified gneiss, generally solid, and without seams, but extremely irregular in surface, with ragged peaks projecting above the general level, due to the verticality of the strata. Between these projections lie bowlders of all sizes, compacted together with sand and gravel.

The presence of the gravel and sand interferes greatly with the operation of the drills, which must be kept clear by means of a jet of water.

When the sand stratum has any depth, it must be removed by dredging, to clear the rock.

The drilling platform (described in report of 1880) consists of a heavy frame supported on four spuds, of adjustable length, which have iron shoes resting on the bottom. A traveler on the frame carries two Burleigh drills. The whole is substantially constructed, and is transported by floating a scow under it at low-water, and as the tide rises hoisting the spuds.

During the past year an apron extending up stream at an angle of about 45°, resting upon the platform and the bottom, was added as a water-break for the protection of the diver while placing the drills. Star-drills 3 inches in diameter and reducing as drilling progresses have, since the application of the water jet at the foot, been satisfactorily used by the contractors.

The delay in the completion of the first contract was due to several causes, the principal ones being, 1st, the necessarily experimental character of such work at the commencement; 2d, the limited appropriation and the uncertainty of obtaining a second contract, which prevented the contractor from at first securing the expensive plant required for rapid and economical work; and 3d, the unfavorable character of the locality.

The contractor's plant was in close proximity to the channel, and the passage of large vessels occasioned frequent accidents.

The tidal currents are strong, and the winds frequently raise a heavy sea that suspends work. The winter began early, and nothing could be done in the spring before April 25, 1881.

Contract under the $40,000 appropriation of June, 1880, was made in August, 1880, and is now in force. The result will probably be the removal of an additional strip of ledge 35 feet in width, with a length of about 750 feet and an average depth to reach 24 feet, of 2.7 feet, of all material, mostly of solid rock.

Under the appropriation of March 3, 1881, of $40,000, a third contract has been made, which it is estimated will suffice to take off another strip of similar dimensions and remove some of the remaining peaks.

The two contracts, which are held by the same contractors, will make an effective addition of 70 feet to the existing 150 feet wide channel, 24 feet deep, increasing it to 220 feet.

Although the stipulated time for the completion of this third contract is twelve months from next March, yet the contractors holding both the second and third contracts will thereby be enabled to work to much greater advantage. They intend, and express confidence in their ability, to complete them both before the close of the fiscal year 1881–'82, when work will be suspended, unless further appropriation shall have been previously made.

It is scarcely possible to overstate the value of this improvement to the commerce of the Delaware River, especially that to foreign ports, as well as to the naval interests of the United States.

Nothing short of the complete obliteration of this reef, and of the minor, though not less dangerous peaks in its vicinity, can prevent continued disaster, and satisfy the urgent demands for safe navigation.

The amount of appropriation for the year 1882–'83 should not be less than the balance of the estimated amount necessary to remove it, viz, $97,000, and this sum should be allotted at one time, in order to admit of making contracts at favorable prices.

Should this appropriation be made, the completion of the improvement as originally estimated may be confidently relied upon, but the more recent knowledge of the details of the river-bed, derived from the repeated and minute examinations which the work has occasioned, has made it evident that the scope of operations must ultimately be increased. Additional lumps and peaks have been and will be discovered, and surfaces of considerable area will be found to have a depth less than is required. Immunity from serious accidents can only be purchased by the removal of these obstructions, the only ones of similar character at present known to exist in the Delaware River.

The commerce to be benefited by this improvement is nearly the whole maritime business of the Delaware, given in the report of Delaware River below Bridesburg, Pa.

This work is in the collection district of Philadelphia, which is its nearest port of entry, the revenue collected there during the past fiscal year amounting to $11,213,825.44.

The nearest fort and light-house are respectively Fort Mifflin, and Schooner Ledge Range lights.

Total appropriations to June 30, 1881	$130,000 00
Total expenditures to June 30, 1881	51,792 60
Original estimated cost of the work	227,000 09

Money statement.

July 1, 1880, amount available	$55,558 59	
Amount appropriated by act approved March 3, 1381	40,000 00	
		$95,558 59
July 1, 1881, amount expended during fiscal year exclusive of outstanding liabilities July 1, 1880		17,346 28
July 1, 1881, amount available		78,212 31
Amount (estimated) required for completion of existing project		97,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		97,000 00

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, at 12 *o'clock m, August* 5, 1880, *for removal of rock for improvement of Schooner Ledge, Delaware River.*

No.	Names of Bidders.	Residence.	Removal of rock.	Remarks.
			Per cu. yd.	
1	National Dredging Company	Washington, D. C	$25 60	
2	American Dredging Company	Philadelphia, Pa	17 00	Lowest bidder.
3	Thomas Cuming	Hackensack, N. J	26 80	

Abstract of contract entered into by Col. J. N. Macomb, Corps of Engineers, during the fiscal year ending June 30, 1881, for removal of Schooner Ledge, Delaware River.

Name of contractor.	Residence.	Removing rock.	Date of contract.
American Dredging Company	Philadelphia, Pa	*Per cu. yd.* $17 00	August 28, 1880.

F 4.

IMPROVEMENT OF DELAWARE RIVER, NEAR CHERRY ISLAND FLATS.

The construction of the channel through Cherry Island Flats was continued during the past fiscal year, partly under the contract of September, 1879, made pursuant to the original appropriation, act of March 3, 1879, and completed in August, 1880, and partly under a second contract made August 16, 1880, pursuant to act of June 14, 1880.

The second contract will have been completed in August, 1881, and thereafter the work will proceed without interuption under a third contract to be made in pursuance of act of March 3, 1881.

The original project (Annual Report Chief of Engineers, 1879, pages 436, 438), contemplated a channel 24 feet deep at mean low-water, with a width of 900 feet. The estimated amount of dredging required was 1,520,000 cubic yards, which, at 20 cents, would cost $304,000.

The progress of the work since its commencement is shown in the following tables the "cuts" being the successive longitudinal excavations made by the dredges from end to end of the channel.

TABLE I.—*Details of dredging operations.*

No. of cut.	Begun.	Completed.	Width.	Cubic yards removed.	Remarks.
			Feet.		
1	Oct. 10, 1879	Mar. 4, 1880	45	100,890	West side of cut located 60 feet west of axis.
2	Mar. 5, 1880	May 17, 1880	40	113,612	West side of cut located 15 feet west of axis. East side of cut located 25 feet east of axis.
3	May 8, 1880	June 23, 1880	25	70,053	East side of cut located 50 feet east of axis
4	June 24, 1880	Aug. 5, 1880	40	93,922	East side of cut located 90 feet east of axis.
5	Aug. 6, 1880	Sept. 24, 1880	40	82,957	East side of cut located 130 feet east of axis.
6	Sept. 26, 1880	Dec. 3, 1880	40	119,065	East side of cut located 170 feet east of axis.
7	Apr. 20, 1881	600 yards to complete.	40	124,875	East side of cut located 210 feet east of axis.
Totals		June 30, 1881		705,374	

Table II.—*Summary of appropriations and contracts.*

Appropriations.			Contracts.				Work.		Money.	
Numbers.	Date.	Amount.	Made.	Price per cubic yard.	Begun.	Ended.	Removed cubic yards.	*Cost per cubic yard.	Expended.	Not expended.
				Cts.				*Cts.*		
1	Mar. 3, 1879	$100,000	Sept. 8, 1879	23	Oct. 1879	Aug. 1880	396,235	25.24	$100,000 00	None.
2.	June 14, 1880	100,000	Aug. 16, 1880	21.7	Aug. 1880	July 1, '81, incomplete.	309,139	24.03	74,288 42	$25,711 58
3.	Mar. 3, 1881	100,000	Aug. 1881	21	Aug. 1881	Aug. 1882	....	23.10	....	100,000 00
	Totals ..	300,000	....	......	....	....	705,374	......	174,288 42	125,711 58

* This cost includes all engineering and incidental expenses, which amounted to 10 per cent. on the contract prices very nearly.

It appears from table I that the average contents of each cut was 100,000 cubic yards, and the average time required for each was two months, omitting the first cut as exceptional, both on account of the season and the incompleteness of the contractors' preparations. The average product per month was therefore 50,000 cubic yards.

The total width of channel attained to July 1, 1881, was 270 feet, of which 60 feet lay to the west of the axis (which is also the line of range-lights) and 210 feet to the east, the greater part of the work having been done on that side on account of the deeper cutting and greater proportion of sand to mud. Also, that while operations continued during the open winter of 1879–'80, they were suspended in 1880–'81, from early in December till late in April. The early and long continued formation of ice was the cause of this.

Table II shows that three successive appropriations have been made of $100,000 each, making nearly the full amount of the original estimate; that up to July 1, 1881, there had been removed 705,374 cubic yards, and that $25,700 of the second appropriation and the whole of the third were unexpended at that date; that the second contract would be completed in August, 1881, and the third by August, 1882.

The amount of material to be removed under the remainder of the second contract is 107,725 cubic yards. Under the third contract it is estimated there will be dredged 432,900 cubic yards. The total under the three appropriations will therefore be 1,246,000 against the 1,520,000 of the original estimate. The remainder, 274,000 cubic yards, will, at the latest cost of 23.1 cents, require an additional amount of $63,300 for its removal. The shortage is due to the fact that the price of 20 cents per yard has never been realized, and for this the system that gives out the work in annual amounts with no guarantee of continuance is directly responsible. The successive lowering of price year by year shows this. The plant required to accomplish so large an amount of work in one year is costly, and in the absence of any security of renewal the contractor is compelled to make such prices as will compensate him for getting it together. The contract rates are, for 1879, 23 cents; for 1880, 21.7 cents, and for 1881, 21 cents. Had it been possible to put the whole $300,000 under contract at one time, 20 cents would have covered the cost. The loss to the government, therefore, due to this cause, is 20 per cent. of the total, without any corresponding advantage to the contractor.

But the amount required for completion of the dredging must be still further enlarged for another reason.

The original project was based upon a chart made for the Light-House Establishment from recent surveys. When actual work began the line, which was to be both the axis of the new channel and that of the range lights to be built by the Board, was readily laid down on the ground. The plane of reference, viz, the height of mean low-water which controlled the depth of cutting, remained to be determined. This office was in possession of records giving the plane of mean low-water at Marcus Hook and at Fort Delaware with accuracy.

These localities are respectively about 8½ miles above and 10 miles below the middle of the cut at Cherry Island Flats, and having been connected by a line of levels, the low-water slope of the river was determined.

From this plane the elevation of mean low-water at Cherry Island Flats was assumed.

Actual tidal observations in the vicinity of the work since June, 1879, have corroborated the assumed elevation and established an accurate low water plane within ± 0.1 foot.

Almost as soon as the dredging began it became evident that, in order to obtain 24 feet at mean low-water, it was necessary to dig about 1.5 feet deeper than the original estimate, and that this amount must be added to the depth to be removed over the entire width of the cut. Furthermore, since the cutting was deeper, the length of these cuts measured along the axis was correspondingly increased. Instead of being 3,620 yards long, as measured in the project of 1878, the length of the cuts was about 4,500 yards. The original project must therefore be amended as follows:

To connect the 24-foot curve near the upper end of the flats with the corresponding curve below will require dredging over a distance of 4,500 yards.

The least depth for any considerable distance along the axis is 17 feet. The average depth over the surface to be removed is 19.5 feet, and allowing 0.2 feet for working depth the average cut is 4.7 feet. The entire quantity of material to be removed is 2,115,000 cubic yards.

As originally estimated this amount was $1,520,000. The difference equals 595,000 cubic yards, which, at 23.1 cents per yard, equals $137,445. This represents the increase to the original estimate due to the error in elevation of the plane of mean low-water on the chart of 1878.

There is a third cause of increase much less in amount and obscured by coördinated complications. After completing the third cut the breaking up of the bottom and the energetic action of the increased flow developed a scour that tended towards filling up the channel, particularly about two-thirds of the distance, through measuring down stream. The shoaling in the absence of any marked lowering of the bottom outside the cut is apparently due to the current attacking the bed at some point of least resistance and deeply excavating it. The lighter material floats off, while the sandy component accumulates and forms a wave in the channel below the excavation. It was necessary to counteract this, and in consequence 31,372 cubic yards were redredged at the price of the first contract.

Furthermore, the scow measurement of material exceeded on June 30 the measurement in place, assuming the sides of the cut to be vertical, by 71,000 yards. This quantity was in most part due to the breaking down of the sides of the cut, which would have made no difference had the contract price for all the work been the same. It came, however, almost entirely as an extra to the first contract, at the highest rate. From both causes the amount involved is $17,920. The additions to the original estimate are therefore as follows:

For correction of mean low-water plane	$137,500
For excess of cost over estimate	63,300
For excess of work on first three cuts	17,920
Total required	218,720

It is as yet impossible to assert positively what precise action the tidal currents will have upon the deposit or removal of silt. As previously stated on the completion of the third cut, when the sum of the widths was 110 feet, it was found that cuts Nos. 1 and 2 had filled considerably, but a certain portion of this certainly came from the breaking down of the vertical margins. Again, after the completion of the sixth cut, the channel width being 250 feet, a slight filling was found along the middle, and the redredging required amounted to 30 yards only to regain the 24 feet at mean low-water.

A survey of the whole locality made in March and April, 1881, gave interesting results. A large portion of the new channel, notwithstanding the suspension of dredging since the previous December, exhibited evidences of scour. Much of the bottom was below grade to 27 and 29 feet, and upon comparison with the 1878 chart, corrected to the true low-water plane, it was found that no less than 73,700 cubic yards had been scoured below the 24 feet plane. The result during the ensuing winter, as it will be reported next year, will exhibit with some assurance of certainty the probable action of the currents. It can, however, be asserted that hitherto, with the exception of a spreading apart of the entrances to the channel, the scouring action has tended to deepen the channel rather than to widen it. It seems probable that as the channel is widened the scour will increase and the silt be abraded rather from the sides than from the bottom.

In April, 1880, the new range lights constructed for this channel were lighted and the channel has since been available for shipping. The inconvenience of the partial occupation of the channel by the contractor's plant with the mooring lines and buoys has been considerable, but as the cut widens these disadvantages decrease.

On June 30, 1881, the channel had a width of 90 yards.

The unexpended balances of the second and third appropriations will widen this to 165 yards, leaving a further width of 135 yards to be obtained.

In accordance with the recommendations of this office, approved by a Board of Engineers (Annual Report of the Chief of Engineers, 1880, pages 574–'76), the dredgings are deposited upon the low lands which border the Delaware and Christiana rivers and are protected from overflow by means of dikes.

The dredge in the channel loads the spoil into scows which, when filled, are towed to a basin opposite the work on the Delaware shore and dumped. A second dredge working in the basin lifts the dredgings into cars (run out on a "tramway," the local name for a railroad track on piles), which are coupled in trains of five to eight, and, when filled, are hauled out by a locomotive over the marsh and their loads discharged. The material, consisting mainly of soft mud and sand, flows 100 to 200 yards and is filled to a depth of 10 to 17 feet. The surface exposed to sun and air soon dries and the solidification gradually extends to the bottom. A United States inspector, on the channel dredge, keeps the position of his dredge by sextant angles, sees that the cutting is done to the proper depth and on the line of shore ranges constructed for the purpose, and sends a bill of lading with each scow load. The bill of lading is received by a shore inspector who verifies it, supervises the dumping, and also the redredging into cars. The inspectors make weekly reports, inclosing the bills of lading. The material is paid for by the scow measurement received at the basin, after the spoil has been redredged and deposited on the marsh.

When the channel dredge sends spoil to the basin in greater quantities than the second dredge can dispose of it, the contractor continues operations at night by aid of the electric lights.

Great benefit to the work has resulted from the successive contracts having been secured by the same contractor, operations having been continuous and at a gradually decreasing cost.

While it is a matter of regret that the total estimate for the completion of this work must be increased so largely, the importance of it cannot well be overestimated.

The length of the cut, nearly 2½ miles, renders it necessary that the width should bear some proportion thereto, and admit of the safe passage of two large steamers in opposite directions. The width originally contemplated, 900 feet, is as small as will admit of this.

The value of the improvement, when completed, to the commerce of the Delaware, will justify the cost and the sectional area should be fully reached in order that a volume of water sufficient to prevent accumulations and to produce a beneficial scouring action, shall be enabled to traverse the channel.

For the fiscal year 1882-'83, an appropriation of $136,000 could be profitably expended.

The commerce to be benefited by the improvement is nearly the whole maritime business of the Delaware, given in the report of the Delaware River, below Bridesburg, Pa.

This work is in the collection district of Delaware, the nearest port of entry being Wilmington, Del.

Fort Delaware and Cherry Island range lights are, respectively, the nearest fort and light-house.

Original estimated cost of the work	$304,000 00
Additions, as explained above	218,720 00
Total estimated cost of the work	522,720 00
Total appropriations to June 30, 1881	300,000 00
Total expended to June 30, 1881	179,880 54

Money statement.

July 1, 1880, amount available	$123,952 86	
Amount appropriated by act approved March 3, 1881	100,000 00	
		$223,952 86
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	79,880 54	
July 1, 1881, outstanding liabilities	18,360 74	
		98,241 28
July 1, 1881, amount available		125,711 58
Amount (estimated) required for completion of existing project		222,720 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		136,000 00

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, at 12 *o'clock m., August* 5, 1880, *for dredging of Delaware River, at Cherry Island Flats.*

No.	Names of bidders.	Residence.	Dredging.	Remarks.
			Per cu. yd.	
1	American Dredging Company	Philadelphia, Pa	$0 25	
2	National Dredging Company	Washington, D. C	21.7	Lowest bidder.

Abstract of contract entered into by Col. J. N. Macomb, Corps of Engineers, during the fiscal year ending June 30, 1881, *for improvement of Delaware River, at Cherry Island Flats.*

Name of contractor.	Residence.	Dredging.	Date of contract.
		Per cu. yd.	
National Dredging Company	Washington, D. C	$0 21.7	August 16, 1880.

F 5.

IMPROVEMENT OF SCHUYLKILL RIVER, PENNSYLVANIA.

With the $40,000 appropriation of June 14, 1880, contract was made in October, 1880, for continuing the improvement of the Schuylkill, in accordance with the project heretofore in force, viz, the attainment of a 24-foot mean low-water channel, from the entrance to Penrose Ferry Bridge, and thence to Gibson's 20 feet.

In the specifications the option was offered the contractor either to secure his own place of deposit, behind a suitable dike or bulkhead, or to use the Government plant at Fort Mifflin, consisting of two tramways, with engines, cars and track, and land his dredgings upon the Fort reservation.

He preferred to make independent arrangements, and the contract was so drawn, but the delay in providing a suitable place of deposit was so great, combined with the early and long-continued winter, that active operations on the river were not begun until May, 1881, and an extension of time for the completion of the contract was asked for and granted from June until September, 30, 1881.

The dredges were put at work first in the lower section of the stream, and by June 30, 1881, progress being slow, there had been excavated about 7,000 cubic yards below Girard Point, and 1,500 cubic yards between that point and the bridge, a total of 8,500 yards.

The examination of the work showed at the end of the fiscal year a channel from the Delaware to Girard Point 24 feet deep and 200 feet wide; thence to Penrose Ferry Bridge, 20 feet deep, with the same width; and thence to Gibson's a channel substantially 20 feet deep and 150 feet wide.

Contract under the appropriation of $40,000, of March 3, 1881, will be made previous to close of operation under the present contract, dividing the river into five sections, corresponding to the nature of the material to be excavated in each. This varies from mud, at the entrance, to coarse, heavy mixture of all materials, near Gibson's, and the cost of handling increases accordingly.

It is expected that the appropriation will suffice to remove a total of about 100,000 yards, and that this amount of work, together with that now under contract, will make a channel 24 feet deep, and 250 feet wide from the Delaware to 1,500 feet above Girard Point; and thence to Gibson's, a 20-foot channel 175 feet wide.

These channel dimensions are quite inadequate to the accommodation of the heavy traffic of the Schuylkill, and it has been in contemplation, for some time past, to prepare a new project, having greater widths and depths in view; but, as stated in the last annual report, the establishment of carefully considered Port Wardens' lines, which shall define the position and character, and limit the extension of structures upon both banks, has so important a bearing upon the permanent improvement of the navigation that the final adoption of such lines should precede the preparation of the project.

The work of the commission of United States officers, Advisory to the Board of Harbor Commissioners, is elsewhere referred to under the title, "Port Wardens' line, Philadelphia"; and although there has been unexpected delay, due perhaps to the cumbrousness of the local machinery for effecting such determinations, it is expected that the matter will be finally concluded in time to admit of the preparation of the project during the ensuing winter.

Resurveys were made of the hydrography from the Delaware to Yankee Point in October, 1880, and again from the entrance to channel back of League Island in March, 1881. The charts of these examinations, which are rapidly and inexpensively made, are essential to a proper knowledge of the stream, and constitute in effect a history of the improvement.

In view of the increased channel dimensions required an appropriation of $50,000 is asked for the fiscal year 1882-'83, an amount $10,000 greater than the appropriations made in 1880 and 1881.

The total of appropriations to the present time is still $75,000 short of the estimated cost of the restricted project now in force.

This work is in the collection district of Philadelphia, at which, as a port of entry, there was collected during the past fiscal year revenue to the amount of $11,213,825.44.

The nearest fort and light-house are respectively, Fort Mifflin and Schuylkill range lights.

Total amount appropriated to June 30, 1881	$300,000 00
Total amount expended to June 30, 1881	222,674 21
Estimated cost of present project	374,700 00

Money statement.

July 1, 1880, amount available	$40,001 21	
Amount appropriated by act approved March 3, 1881	40,000 00	
		$80,001 21
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,675 42
July 1, 1881, amount available		77,325 79
Amount (estimated) required for completion of existing project		174,700 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		50,000 00

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, at Philadelphia, Pennsylvania, at 12 *o'clock m., October* 11, 1880, *for dredging in the Schuylkill River, Pennsylvania.*

No.	Names of bidders.	Residence.	Contractor to use his own plant and secure his own place of deposit.							
			Beween mouth of river and Girard Point piers; 44,000 cubic yards.		Between Girard Point piers and Penrose Ferry Bridge; 29,000 cubic yards.		Between Penrose Ferry Bridge and Yankee Point; 20,000 cubic yards.		Between Point Breeze and Gibson's Point; 15,000 cubic yards.	
			Rate.	Amt.	Rate.	Amt.	Rate.	Amt.	Rate.	Amt.
			Cts.		*Cts.*		*Cts.*		*Cts.*	
1	National Dredging Company.	Washington, D. C.	37½	$16,500	37½	$10,875	37½	$7,500	37½	$5,625
2	American Dredging Company.	Philadelphia, Pa.	32	14,080	35	10,150	42	8,400	48	7,200
3	Frank Pidgeon, jr ...	New York, N. Y.	29	12,760	29	8,410	34	6,800	34	5,100

No.	Names of bidders.	Total amount for contractor to use his own plant and secure his own place of deposit.	Contractor to use government plant and deposit on government lands.								Total amount; contractor to use government plant and deposit on government lands.
			Between mouth of river and Girard Point piers; 44,000 cubic yards.		Between Girard Point piers and Penrose Ferry Bridge; 29,000 cubic yards.		Between Penrose Ferry Bridge and Yankee Point; 20,000 cubic yards.		Between Point Breeze and Gibson's Point; 15,000 cubic yards.		
			Rate.	Amt.	Rate.	Amt.	Rate.	Amt.	Rate.	Amt.	
			Cts.		*Cts.*		*Cts.*		*Cts.*		
1	National Dredging Company.	$40,500	34	$14,960	34	$9,860	34	$6,800	34	$5,100	$36,720*
2	American Dredging Company.	39,830	30½	13,420	33½	9,715	41½	8,300	46½	6,975	38,410†
3	Frank Pidgeon, jr...	33,070	34	14,960	34	9,860	39	7,800	39	5,850	38,470‡

* Provided they are awarded contract for Mifflin Bar.
† Provided they are allowed the exclusive use of the government plant.
‡ Lowest bidder.

Abstract of contract entered into by Col. J. N. Macomb, Corps of Engineers, during the fiscal year ending June 30, 1881, *for improvement of Schuylkill River, Pennsylvania.*

Name of contractor.	Residence.	Between the mouth of the river and Girard Point piers; rate per cubic yard for dredging.	Between Girard Point piers and Penrose Ferry Bridge; rate per cubic yard for dredging.	Between Penrose Ferry Bridge and Yankee Point; rate per cubic yard for dredging.	Between Point Breeze and Gibson's Point; rate per cubic yard for dredging.	Date of contract.
Frank Pidgeon, jr	New York City...	$0 29	$0 29	$0 34	$0 34	Oct. 25, 1880

COMMERCIAL STATISTICS OF SCHUYLKILL RIVER, PENNSYLVANIA.

Number of vessels at Point Breeze from July 1, 1880, *to June* 30, 1881, *and total shipments of petroleum within same period.*

Steamers	7
Ships	44
Barks	212
Brigs	22
Schooners	30
Sloops	
Barges	24
Total vessels	339
Total barrels	994, 313

Number of vessels and estimated shipments of petroleum from Gibson's Point from July 1, 1880, *to June* 30, 1881.

Ships	17
Barks	84
Brigs	9
Schooners	2
Barges	15
Total vessels	127
Total barrels	269, 847

Number of vessels at and shipments of grain from Girard Point elevator from July 1, 1880, *to June* 30, 1881.

Steamers	59
Ships	31
Barks	148
Brigs	2
Schooners and barges	17
Sloops	13
Total vessels	270
Total bushels	9, 548, 123

Elevator burned April 28, 1881.

F 6.

ICE HARBOR AT MARCUS HOOK, PENNSYLVANIA.

The construction of this harbor in its modern improved condition was begun in 1867 and completed in 1871. It then consisted of two landing-piers of wood, about 600 feet apart, each connected with the shore by a bridge and causeway, with a total length of about 380 feet, and four detached piers of stone, inclosing an available harbor space of about 600 feet by 250 feet—3½ acres—the low-water mark reaching nearly to the ends of the landing-piers.

With the increasing commerce of the Delaware, the use of the harbor rapidly augmented, and these dimensions being found inadequate to furnish the necessary shelter, the river and harbor act of March 3, 1879, directed an examination and report to be made, with the view of enlarging them. The report, dated January 24, 1880, was printed in Annual Report Chief of Engineers for 1880, pages 612–614.

The project for enlargement, as there presented, was—

1st. To construct a third line of piers about 600 feet farther down stream, either of iron, continuous to the shore, or of three detached stone piers similar to the others, thereby increasing the harbor space from 3½ to 7 acres. The third pier on the new line was to take the place of the landing-piers on the other two. In the printed report a misprint is made of *two* piers for *three*.

2d. To again double the acreage to 14 by dredging shoreward about 250 feet inside the low-water mark and within the enlarged limits of the harbor.

The estimated cost of this project was $90,000, by which the sheltered area would be increased fourfold. Towards its execution the river and harbor act of 1880 made an appropriation of $35,000, and under this a contract was made in August, 1880, for the construction of the two outer piers. These piers differ from the others only in having pile instead of crib foundations, a method of construction offering certain advantages in rapidity and economy of execution, with equal efficiency if properly done. For the rest, the superstructure above low-water has stone faces bonded and clamped with rubble, and concrete filling and parallel sides, with starling ends up and down stream, the upper surface paved, and 70 feet long from point to point by 30 feet wide from side to side.

The third pier was not contracted for, because it had become evident that, by a modification of the project, its usefulness could be greatly increased.

The two piers were to have been completed by December 1, 1880, at a cost of about $21,000, but various delays occurred, and the winter closing in sharply an extension of time was given to June 1, 1881, and subsequently to August 31, 1881.

Meanwhile seven clusters of mooring-piles of white oak, five in each cluster, were driven along low-water mark about 150 feet apart, the work being completed at a cost of $432, in time to be of great service to vessels during the winter.

By June 30, 1881, the outer pier had been nearly completed, and of the inner pier the foundation and two courses of superstructure had been built. Both are to be completed by September 1, 1881.

By the act of March 3, 1881, a further sum of $30,000 was appropriated, making a total of $65,000 out of the $90,000 of the original estimate.

A more complete study of the present and future requirements of this harbor, and examination of the locality, indicate that without unduly increasing the ultimate cost its dimensions may be made adequate to the needs of navigation for some years to come.

An amended project, embodying the results of this study, will shortly be submitted. Its general features may by stated as follows:

1st. The suppression of the innermost pier of the third line now constructing and its transfer to a point 500 feet down stream and about 200 feet distant from and opposite to a private pier; the two to constitute, in effect, a fourth line of piers and the lower limit of the harbor.

2d. The construction of a substantial bulkhead with mooring-posts the entire length of the harbor, on a line about half way between high and low water marks.

3d. To dredge the bed of the harbor from the 15-foot low-water curve, shoreward shoaling to about 10 feet alongside the bulkhead.

4th. To fill the space between the bulkhead and high-water mark to about 9 feet above low-water with the material dredged from the outer space.

The effect of these constructions will be the increase of the harbor space to over 18 acres, about 4 acres in excess of that hitherto proposed, and these 4 acres will be gained at an expense of $8,000 only over the cost of the original project, viz, $90,000.

The Board of Port Wardens, and others interested in the navigation and commerce of the Delaware, are in full accord with this project, and the great majority, both in numbers and interest, of the riparian owners are earnestly desirous of its early accomplishment. The accompanying tracing illustrates the project.

I respectfully recommend that Congress be asked to formally authorize this project, including the construction of the bulkhead and the dredging, and that in addition to the sum now available appropriation be made, for fiscal year 1882–1883, of $25,000.

The necessity for some supervision and control of the use of the harbor during the ice season is referred to in the reports for New Castle ice harbor, and in the report of the Delaware River, under the title "Ice Harbors," to which attention is respectfully invited.' It is strongly recommended that the United States engineer officer in charge of construction shall be authorized, so long at least as the harbor shall be constructing, to appoint a harbor-master, who shall be empowered to suitably regulate the use and occupancy of the harbor and prevent abuse of its advantages.

The commerce to be benefited by this harbor is nearly the whole maritime business of the Delaware, given in the report of the "Delaware River below Bridesburg, Pa."

Marcus Hook is in the collection district of Philadelphia, at which, as the nearest port of entry, the revenue collected during the past fiscal year amounted to $11,213,825.44.

The nearest fort and light-house are, respectively, Fort Mifflin and Christiana light.

Total estimated cost of project	$90,000 00
Increase, as herein recommended	8,000 00
Total, as now estimated	98,000 00

Total appropriations for this harbor to June 30, 1881	169,000 00
Total expenditures to June 30, 1881	107,826 00

Money statement.

July 1, 1880, amount available	$35,000 00	
Amount appropriated by act approved March 3, 1881	30,000 00	
		$65,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	3,826 09	
July 1, 1881, outstanding liabilities	20,495 00	
		24,321 09
July 1, 1881, amount available		40,678 91
Amount (estimated) required for completion of existing project		33,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		25,000 00

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, at 12 o'clock m., August 17, 1880, for construction of piers in Marcus Hook Harbor, Pennsylvania.

No.	Names of bidders.	Residence.	Construction of two piers.		Time of completing.	Remarks.
			Amount bid for pile foundation.	Amount bid for crib foundation.		
1	Leiper & Lewis	Chester, Pa	$32,700	$31,900	July 1, 1881	
2	William Wesley Upp	Columbia, Pa		32,000		
3	Frank Pidgeon, jr	New York City	25,840	35,150	Nov. 15, 1880	
4	John T. Rowe, president Mount Waldo Granite Works.	Frankfort, Me	20,495	24,076	Dec. 10, 1880	Lowest bidder

Abstract of contract entered into by Col. J. N. Macomb, Corps of Engineers, during the fiscal year ending June 30, 1881, for construction of piers in Marcus Hook Harbor.

Name of contractor.	Residence.	Price of the construction of two piers.	Date of contract.
Mount Waldo Granite Works, John T. Rowe, president.	Frankfort, Me	$20,495	September 1, 1880

F 7.

ICE-HARBOR AT CHESTER, PENNSYLVANIA.

The annual report for 1879–'80 suggests that so soon as suitable accommodations shall have been elsewhere provided, this harbor should be abandoned to general uses, and expenditures upon its maintenance omitted. The reasons for this are the limited space now available, the impracticability of any extension, and the perishable character of its wooden piers and the connecting bridges. The piers are now used as a landing for the steamboats and other vessels having occasion to touch at Chester, and since the value of the harbor to the general commerce is small and constantly diminishing, it would seem proper that such repairs and expenditures as are required should be made either by the city of Chester or by the persons making use of it.

No further appropriations are asked.

Total appropriations to June 30, 1881	$32,933 00
Total expenditures to June 30, 1881	32,900 76

Money statement.

July 1, 1880, amount available		$82 24
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		$50 00
July 1, 1881, amount available		32 24

F 8.

ICE-HARBOR AT NEW CASTLE, DELAWARE.

In accordance with the recommendations made in the last two annual reports, the act of March 3, 1881, appropriated $20,000 for the construction of the additional pier needed to perfect the design of this harbor, and to secure shipping, seeking shelter therein, against the impact of ice during flood tide. While awaiting the action of Congress in this regard, no application was made of the balance of $3,700 on hand at the beginning of the fiscal year.

During the winter, which was one of extraordinary severity, two of the piers were struck by vessels, several of the stones being broken, and others thrown off into the deep water alongside.

Advertisements were issued in May, and bids opened June 18, for the construction of the new pier. Owing to advance in cost, both of labor and material, the lowest bid ($21,949) was in excess of the estimate ($20,000) by nearly $2,000. The contract was made July 6, the work to be completed by January 1, 1882, in time to be available for the winter.

By reason of this increased cost, and in order to provide for making the necessary repairs and complete the dredging required to put the harbor in good condition, an additional appropriation of $3,000 is needed, the expenditure of which, unless further accidents should occur, will render the harbor thoroughly efficient for many years.

Until the construction of the proposed harbor at or near Lisbon's shall have so far advanced as to furnish shelter for shipping during the ice season, the 6¼ acres of the New Castle Harbor is the most important and necessary refuge on the Delaware River, and after its completion the use and occupation of the harbor space should not be left without proper supervision. Attention has been called to the necessity for this in previous reports, and the matter is referred to anew, with recommendations, in the annual report for Delaware River, under the heading of ice harbors

This harbor is in the collection district of Delaware, Wilmington being its nearest port of entry. The nearest fort and light-house are, respectively, Fort Delaware and the Bulkhead Shoals range-light.

Total appropriations to June 30, 1881	$130,000
Total expenditures to June 30, 1881	106,261

Money statement.

July 1, 1880, amount available	3,739 76	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$23,739 76
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	86 51	
July 1, 1881, outstanding liabilities	86 61	
		173 12
July 1, 1881, amount available		23,566 64
Amount (estimated) required for completion of existing project		3,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		3,000 00

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, Philadelphia, Pa., at 12 o'clock m. of June 18, 1881, for the construction of an ice pier in New Castle Harbor, Delaware.

No.	Names of bidders.	Residence.	Price completed.	Commence work.	Complete work.	Remarks.
1	Mount Waldo Granite Works.	Frankfort, Me..	$21,966	....	Present season	
2	Leiper & Lewis..	Media, Pa	23,995	10 days after contract is awarded	January 1, 1882.	
3	W. Wesley Upp.	Columbia, Pa...	23,400	....	January 1, 1882.	
4	Frank Pidgeon, jr.	Philadelphia, Pa.	21,949	Within 60 days of notice of award.	Before navigation closes.	Lowest bidder

F 9.

IMPROVEMENT OF WILMINGTON HARBOR, DELAWARE.

The improvement of the entrance to and channel of Christiana River, which constitutes the harbor of Wilmington, was begun in 1871, under a project for securing a 12-foot mean low-water navigation to the city.

The estimated cost of the necessary rock and silt excavation was $83,000, and the actual cost, including the $10,000 appropriated in act of June 14, 1880, has been $83,500.

The operations of the past fiscal year have completed this work by dredging the bar at the entrance from 9 or 10 feet, at low-water to 13 feet.

The contract was made with the National Dredging Company, at 24 cents per cubic yard; the material to be landed on the meadows bordering the Christiana.

Operations began in October, and were completed in November, after dredging and landing 35,630 cubic yards of mud.

The resulting channel has a depth of full 13 feet at low-water, with width of 150 feet connecting the deep water inside the Christiana entrance with that in the Delaware.

An examination of the mouth in April, 1881, showed that the channel through the bar had maintained itself, and even slightly improved during the winter.

The second section of the act of June, 1880, called for a survey of the "Christiana River from the Delaware Railroad Bridge to the mouth of the river, with an estimate of the cost of procuring a mean depth of 15 feet in the channel thereof."

The results of the survey were exhibited on a chart submitted with report of January 7, 1881, a copy of which is forwarded for incorporation herewith.

The chart shows that the originally projected 12-foot low-water navigation has been attained, and that of the distance of 16,200 feet from the buoy depot at the entrance to the bridge of the Delaware Western Railroad, about 6,800 feet, or 42 per cent., has a mean low-water channel depth of 15 feet and over. If the distance from the bridge in question to the pulp works, 2,400 feet, be added, the percentage of 15-foot channel in the whole distance, viz, 18,600 feet, is 37 per cent.

The rise of tide at the upper limit of the survey was nearly as great as at the mouth, and the conditions generally appeared favorable to the construction of a 15-foot low-water navigation, with two exceptions, viz:

First. After escaping the confinement between the dikes, which constitute the high-water banks of the stream, the effluent waters of the Christiana spread fanwise, and are exposed to the influence of the tides and waves of the Delaware. Under these circumstances their scouring effect is partially destroyed, and the normal low-water depth on the bar appears to be 9 or 10 feet only.

The manifest remedy is the construction of a jetty, so planned as to control and direct the Christiana ebb, and protect it from the greater volume of the Delaware currents, without injurious interference with the free admission of the flood tide.

By the aid of such a jetty the channel to be thereafter dredged should be able to maintain itself, although the occasional assistance of artificial deepening may be required.

Second.—The city of Wilmington, built on a sloping site, with over 40,000 inhabitants, engaged in extensive and varied manufacturing industries, has no sewer system, nor effective street-cleaning regulations.

In consequence, the accumulation of solid material in the bed of the stream is very large, and the river front is constantly filling up, by reason of the general deposit therein of street washings, waste products, sewage, and other refuse. This primitive method of getting rid of useless or objectionable matter, probably did no great harm when the town was small, and the absolute amount of refuse not great. With the increased population and business, the river is no longer able to absorb it, and evils already existing cannot fail to become more formidable year by year.

Until the city shall have taken the necessary steps to protect a navigation so valuable to its commerce, attempts to deepen, or even maintain it, would be unadvisable. Information has been received that the necessary action by the city authorities has been taken, and that the protective measures are in progress.

With the entrance provided for, and the channel along the city front relieved of extraneous sources of injury, the attainment of a 15-foot low-water navigation would resolve itself into a simple matter of rock and mud excavation.

The amount of the former is fortunately small. With regard to the question of future maintenance, it may be said that, in this respect, the Christiana does not differ from other tidal streams, and that so long as materials for filling are brought into it, their removal at points of deposit will always be necessary.

Aside from washings from banks, and other natural sources, the dependence of the Christiana upon the Delaware for the filling of its tidal prism will alone serve to bring into the stream a considerable amount of mud and light material in suspension.

The removal of this will constitute an annual charge upon the navigation, the amount of which could not probably be calculated in advance with any approach to accuracy.

The total of the estimate for making a 15-foot navigation, as far as the Pulp Works, and thence to the Delaware Railroad bridge, a 12-foot navigation, is, according to the report of January 7, 1881, $175,551, based upon prices considered probable at that time, and the report recommended that for an economical prosecution of it the work should be completed in four years.

The act of March 3, 1881, appropriated $50,000, in pursuance of this report.

The project for the expenditure of this appropriation is to construct the jetty at the entrance, and extend the present 12-foot low-water channel as far as the Pulp Works, as necessary preliminary steps to the commencement of the 15-foot low-water channel. This should then be begun, and carried upward.

The project having been referred to the Board of Engineers, at New York, was approved by them, and will be carried out during the fiscal year 1881–'82.

So soon as the details of the construction of the jetty shall have been decided upon, both works will be put under contract.

There will be required for the continuance of this work, under the approved project, a further sum of $50,000 for the fiscal year 1882–'83, with which the construction of the 15-foot channel will be commenced.

Wilmington is in the collection district of Delaware, and is a port of entry.

The nearest fort and light-house are respectively Fort Delaware and Christiana light.

Total amount appropriated to June 30, 1881	$133,000 00
Total amount expended to June 30, 1881	83,656 00
Total estimated cost of project (of January 7, 1881)	175,551 00

Money statement.

July 1, 1880, amount available	$10,672 36	
Amount appropriated by act approved March 3, 1881	50,000 00	
		$60,672 36
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		10,828 44
July 1, 1881, amount available		49,843 92
Amount (estimated) required for completion of existing project		125,551 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		50,000 00

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, at 12 o'clock m., August 18, 1880, for dredging in Christiana River, Wilmington, Del.

No.	Names of bidders.	Residence.	Price per cubic yard.	To commence.	To complete.
1	National Dredging Company.	Washington, D. C.	$0 24.7	Sept. 9, 1880.	Dec. 30, 1880.

Abstract of contract entered into by Col. J. N. Macomb, Corps of Engineers, during the fiscal year ending June 30, 1881, for improvement of Wilmington Harbor, Delaware.

Name of contractor.	Residence.	Dredging.	Date of contract.	Remarks.
National Dredging Company.	Washington, D. C.	*Per cu. yd.* $0 24.7	August 28, 1880.	Completed November 15, 1880.

SURVEY OF CHRISTIANA RIVER, DELAWARE, FROM THE DELAWARE RAILROAD BRIDGE TO THE MOUTH OF THE RIVER.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., January 7, 1881.

GENERAL: I have the honor to forward herewith report and tracings of chart of Christiana River, Delaware, in conformity with the requirements of the river and harbor act of June 14, 1880.

The improvement of Christiana River, which constitutes the harbor of Wilmington, has been in progress since 1871, under the project adopted at that time, and carried to its completion during the past season by the expenditure of the $10,000 appropriated in the last river and harbor act.

This project called for a 12-foot low-water navigation, of between 100 and 200 feet width, to be secured by dredging and blasting, at an estimated cost of $83,000. The amount that has been appropriated and expended is $83,500, and the chart shows that the full object of the expenditure has been attained. The condition of the navigation, somewhat in detail, is as follows:

There is a clear depth of 13 feet at the entrance, with a width between the 12-foot curves of from 100 to 200 feet. Near the rolling-mill wharf about 5,000 feet above the mouth, the channel deepens to 18 and 20 feet. Between this point and the mouth of the Brandywine, 4,000 feet, the 12-foot channel averages 125 feet in width, with maximum depths of 15 and 16 feet. Between Brandywine and Third street bridge, 3,500 feet, the greater portion of the channel exceeds 15 feet in depth. Ledges of rock exist above and below Third street bridge, and numerous borings were made in the vicinity to ascertain its development. Between Third street and Market street bridges, 4,000 feet, covering the main city front of Wilmington, the 12-foot navigation continues with a reduced width, averaging about 50 feet, and the 15-foot low-water depth occupies about one-fourth of the distance. Between Market street and the Delaware Western Railroad bridges, 2,500 feet, the 12-foot channel increases in both dimensions, with numerous soundings of over 20 feet, and an average width of 100 feet. The improvements hitherto made have terminated just above Market street. At the Delaware Western Railroad bridge the 12-foot curve disappears from the chart. The soundings thence to the Pulp Works, 2,400 feet, are from 9 to 11 feet, and thence to the Delaware Railroad bridge, 7,500 feet, the depth remains about the same, with the exception of a distance of 2,000 feet in the straight reach below Dupont's powder wharf, over which the average low-water depth is 4 to 5 feet. The low-water width of Christiana River is quite uniformly about 300 feet from the Delaware Railroad bridge to the junction with the Brandywine; thence to the mouth it is about 500 feet. The mean range of tide is also uniform within the limits of the survey, 5½ miles, varying from 5.7 feet at the buoy depot, near the entrance, to 5.8 feet at the upper bridge. This uniformity, both in cross-section and tidal range, indicates conditions quite favorable to stability for any future improvement, if not impaired by faulty works.

There is every reason to suppose that a 15-foot low-water navigation, as called for by the river and harbor act, can be secured and maintained, if the proper precautions are taken.

The only point naturally presenting difficulties is the entrance, where the ordinary depth is 8 or 9 feet, and the greater draught could not be maintained without constant dredging in the absence of permanent works. The construction of the deflecting jetty shown on the tracing, would in all probability suffice to maintain an entrance depth of not less than 12 feet, after the necessary dredging had been done, by protecting the ebb current of the Christiana against interference from that in the Delaware before attaining its proper direction, and by tending to gather the flood current without the creation of cross-currents.

As this jetty will have to sustain a considerable pressure of ice at certain seasons, it must be made of sufficient strength, and the outer end should be made especially solid to insure its ability to carry a beacon to mark the entrance. To reduce the cost without impairing the efficiency in any marked degree, the height of the jetty may be kept below that of high-water.

The borings in the vicinity of the rock ledges near Third street bridge prove that the amount of that material to be excavated for a 15-foot channel is fortunately small. The estimate of cost given in the accompanying table separates the river into six sections, lettered respectively from A to F, with channel dimensions diminishing upward. In the lowest section the 15-foot channel has a width of 150 feet. In the next three sections the width is reduced to 100 feet, increasing at the Third and Market street bridges, to allow for the use of both draws, to 150 and 200 feet. Between the Delaware and Western Railroad Bridge and the Pulp Works the channel width is 75 feet, and thence upward to Delaware Railroad Bridge, 50 feet, the depth being uniform.

The Pulp Works mark the present limit of extensive works dependent largely upon water freights. Should that point be made also the present limit for the 15-foot channel, the depth of 12 feet thence to the upper railroad bridge would probably meet all immediate requirements, and effect a considerable saving in the total estimate.

Should sufficient appropriation be made, I would recommend that the works be executed in the following order:

1. The extension of the present 12-foot channel upward to the Pulp Works;
2. The construction of the jetty at the mouth;
3. The dredging of the 15-foot channel from the mouth upward; and
4. The removal of the rock above Third street.

For the completion of the entire project, a period of about four years would probably be required. The division of labor would not necessarily follow the above divisions, which are only intended to indicate the *sequence* of work, and not the annual amount.

An undue protraction of time would increase the ultimate cost of the project.

In regard to the probable future cost of maintenance of the projected 15-foot low-water navigation, it is proper to say that all the indications are favorable, with the exception that at the present time no suitable regulations exist for controlling the deposit of solid materials in the stream.

The drainage and sewage system of the city of Wilmington are of the most primitive character. The city lies on a sloping site, the streets are imperfectly paved, and the washings of all sorts find their way into the Christiana River, without any provision whatever for intercepting their solid contents and preventing them from filling the river bed. To this cause is due the marked deterioration of the navigation between the Third and Market street bridges which exists, notwithstanding the expenditure by the general government and the constant annual outlay by owners of wharf property. Unless this evil can be remedied and the navigation relieved of the great and unnecessary burden thereby thrown upon it, the estimates accompanying this report must be largely increased, and the ultimate maintenance of the improved, or even of the existing, navigation rendered costly and uncertain.

Very respectfully, your obedient servant,

J. N. MACOMB,
Colonel of Engineers.

The CHIEF OF ENGINEERS, *U. S. A.*

Estimate of cost of constructing a channel 15 *feet deep at mean low-water in Christiana River, Delaware, from mouth to Delaware Railroad Bridge.*

SCHEDULE I.—DREDGING.

Sections.	Localities.		Dimensions of channel.		Dredging.	Nature of material.	Price per cubic yard.	Cost.	Remarks.
	From—	To—	Width.	Depth.					
			Feet.	*Feet.*	*Cub. yds.*		*Cents.*		
A	Mouth	Rolling-mill Wharf	150	15	38,400	Mud and sand	28	$10,752	The proposed channel widens at Third-street Bridge from 100 to 150 and 200 feet, and at Market-street Bridge from 100 to 150 feet. Allowances made for channel slopes, varying from ⅛ to ½.
B	Rolling-mill Wharf	Third-street Bridge	100	15	69,800	Mud and gravel	30	20,940	
C	Third-street Bridge	Market-street Bridge	100	15	73,200	......do	32	23,424	
D	Market-street Bridge	Delaware Western Railroad Bridge	100	15	24,300	......do	35	8,505	
E	Delaware Western Railroad Bridge	Pulp Works	75	15	84,800	......do	35	29,680	
F	Pulp Works	Delaware Railroad Bridge	50	15	190,200	......do	35	66,570	
	Totals				480,700			159,871 31,150	
	NOTE.—If Section F be made with a depth of 12 feet instead of 15 feet, a reduction of 89,000 cubic yards can be made from the above, reducing the cost by $31,150, and the total cost would be							128,721	

SCHEDULE II.—ROCK EXCAVATION.

Locality.	Width.	Depth.	No. cubic yards.	Nature of material.	Price.	Cost.
In mid-channel 600 feet above Third-street Bridge	100 feet.	15 feet.	438	Hornblendic gneiss	$35 00	$15,330

SCHEDULE III.—CONSTRUCTION OF JETTY AT MOUTH.

Locality.	Length.	Average height.	Price per running foot.	Cost.
From dike at light-house to 15-foot curve in Delaware River	1,800 feet.	12 feet.	$17 50	$31,500

RECAPITULATION.

Dredging	$159,871
Rock excavation	15,330
Construction of jetty	31,500
Total	206,701
If Section F be made with a depth of 12 feet instead of 15 feet, the total cost would be	175,551

REPORT OF THE BOARD OF ENGINEERS.

OFFICE OF THE BOARD OF ENGINEERS FOR FORTIFICATIONS
AND FOR RIVER AND HARBOR IMPROVEMENTS, &C.,
New York, June 7, 1881.

GENERAL: This Board, to whom was referred the subject of the improvement of Christiana River and Wilmington Harbor, Delaware, for consideration and report, has the honor to present its views thereon as follows:

The information furnished by the Engineer Department to guide us in our investigations consists of Colonel Macomb's report of his survey of Christiana River, with an accompanying chart showing its present condition by soundings and bottom curves from its mouth up to the bridge of the Delaware Railroad, a distance of 5½ miles. By dredging, a low-water depth of 12 feet has been attained in this river as high up as the first or Delaware Western Railroad bridge, as is fully set forth in the report and indicated by the chart.

The last river and harbor act calls for a depth of 15 feet continued throughout that portion of the river embraced in the survey. Colonel Macomb, in his report (January 7, 1881), says:

> There is every reason to suppose that a 15-feet low-water navigation can be secured and maintained if the proper precautions are taken.

He thinks, however, that such depth of channel at this time is needed no farther up the river than the Pulp Works, and that 12 feet (above that point) will quite satisfy the necessities of commerce. To maintain the depth of 15 feet over the bar at the entrance of the Christiana River into the Delaware, in his opinion, will require the construction of a jetty on the north side of the channel curving down stream as marked on chart.

Colonel Macomb's project (see his letter to Chief of Engineers, April 8, 1881) for the expenditure of the last appropriation of $50,000 made by Congress for this improvement designs to apply three-fifths of it to the construction of the proposed jetty and two-fifths to dredging a 12-foot channel-way up stream as far as the Pulp Works.

On the 26th of May Captain Ludlow, Colonel Macomb's assistant, appeared before the Board and gave valuable information in reference to the river and the project for its improvement.

It appears that the dredging of the Christiana River bed, including some rock blasting, has been in progress for the past ten years, under small annual appropriations; that the successful accomplishment of the original plan of improvement, which looked to the attainment of a 12-feet depth only, has prompted the further demand for 15 feet and for a longer reach of the river.

The chart before us shows the river in that portion already deepened as possessing a strongly curved outline throughout the greater portion of its length, a condition very favorable to the maintenance of the depth attained. The gradual narrowing of the stream, with some exceptional parts in ascending, seems to be about sufficient to produce uniformity of current in the ebbing and flowing of tide waters and an equalization in the rise and fall throughout the section (3.6 miles long) to first railroad bridge. This condition, like the former, favors the maintenance of improvements effected.

From Major Bache's report we learn that in the working season of 1839 the Christiana River bed was dredged under his direction, 13,518 cubic yards being removed therefrom. Of this amount 3,505 cubic yards were excavated from the bar of the river at its mouth, the remainder being principally taken along the wharf front of the town of Wilmington. The depth of water thus secured enabled a vessel of 16-feet draught to pass out of the river at high-water without touching, indicating that there must have been 10 feet depth of river in the shoalest part of the channel at low-water. His chart, made in 1835, prior to the dredging, shows shoal water along the town front and at the first bend and current crossing, where the river was wide comparatively; also at the current crossing just above the mouth and at the bar. Since that date the river width has been somewhat reduced along the lower portion of the city front down to the bend below by structures on the north side. Its present width is rather more favorable in that portion to the preservation of the channel depth than its former cross-section.

During the past ten years there have been removed from the river bed between the Delaware and the first railroad bridge, a distance of about 3.6 miles, 210,912 cubic yards of mud, sand, gravel, and rock, giving it a channel depth of 12 feet at its shoalest places, with widths varying from 75 to 150 feet up to Market street bridge. The amount excavated was sufficient to have covered 100 feet width of river bed throughout the improved section to a depth of 3 feet. It appears, however, from the yearly reports of the officer in charge of this work, that somewhat more than one-half of that amount was taken from its bed below the mouth of the Brandywine along three sections aggregating a length of about 1 mile, viz, at the current crossing and straight reach below dredging company's wharves, at the current crossing above light-house, and on bar at entrance into the Delaware River.

As nearly as can be ascertained, the larger part of the balance of dredging was applied at the current crossing at Third street, above and below bridge, and on the city front just above but mostly below Market street, and the remainder near and at the mouth of the Brandywine. The great bend of the river has continued deep. The fact of the large excavation where the two streams join would seem to indicate deposits effected there by the meeting of their currents and the forcing back of the Christiana waters along the north side.

The Christiana River, by the testimony of Captain Ludlow, is sediment-bearing to about the same extent as the Delaware. As the currents of the inflowing and ebb tides exceed 1 mile an hour at times, there must be movement of the bottom, consisting of fine sand and mud. From an examination of Major Bache's map of 1835, the Coast Survey map of 1841, and Colonel Macomb's charts of surveys since made, together with the records of the dredging for the past ten years, we infer that there has been deposit since 1840 on the bar just beyond the mouth of the river, at the current crossing just within its mouth, at the straight portion below the junction of the Brandywine, at the mouth of the Brandywine, at the current crossing at Third street bridge, in the vicinity of Market street bridge, and more or less along the city front. Now, it seems quite probable that the filling along the city front is due almost entirely to the washings from the city, which is built on rising ground sloping to the river. This same material traveling on to the mouth would naturally help to make the deposits at the specified points below the mouth of the Brandywine; this latter river contributing also to that effect. Now, if the solid material from its street washings and sewerage can all be prevented from entering the river, a large source of bottom deposit, will be cut off, and only those from the Christiana above and the Brandywine branch will remain. Of course there is always material brought into the river by the flood-tide to be carried out again by the ebb.

There can be little doubt that if the Christiana River be deepened much beyond the bed-level that has resulted from natural causes, it will in time return to the same bed-level; that is, other features remaining the same, the excavated portions must gradually fill again. It would require a study of the river from its mouth to its sources, with observations upon its currents, its bed movements in the way of traveling bars, bank erosion and material of bank and bed, effects of floods, &c., to determine the probabilities as to the rate of refilling. The river is favorable for improvement in this, that it is not largely sediment-bearing, from the fact that for a large portion of its length below the city the least low-water channel depth prior to any excavation exceeded 12 feet, and as the excavations already made have not generally extended more than 2 feet below the natural bed, it would seem but a reasonable inference that the 12-foot channel now reached may be maintained without much expense, provided the city drainage into the river can be cut off.

The maintenance of a 15-foot channel will be more difficult, and it seems probable that dredging from time to time will be required, at points before named, to keep up that depth. A slight narrowing of the river at and near the Dredging Company's wharves, and a dike at the crossing at the mouth extending from the high to the low-water line, may be needed to hold the depth of 15 feet at those reaches of the river. The crossing at the Old Ferry evidently favors deposition as well as the crossing below Market street. The tendency to fill at these points may be due mostly to the large quantities of material coming from the city drainage, for the river is narrow enough to give a good scouring velocity at both of these reaches.

Throughout the greater portion of its length between the two railroad bridges the Christiana is somewhat wider than along the city front—a condition favorable, in this, that it constitutes a basin to receive the inflowing tide, and thus to increase the velocity of the outflow to maintain the depth of river below. But it is not a condition favorable to the wider portion of this reach of the river, as the slackening of the current, due to the greater width, both in the influx and efflux, causes deposition. We find the water generally shoal in this reach, except in the curved and narrow portions. Excavating a channel 12 feet deep will give more ready access to the incoming tide, and will admit rather more water above the second railroad bridge, provided the river lines and bed are favorable to its ready ascent. Gaugings indicate that an average of nearly 50,000,000 cubic feet ascend above the second railroad bridge at each influx of the tide. That amount of water would give an average velocity of outflow through the straight reach below Dupont's Powder Mill of about three-fourths of a foot per second, whereas the average velocity of outflow in the straight reach of the city front below Market street is about 1 foot per second, now that it is excavated to a depth of 12 feet. If a channel-way between bridges be excavated to a depth of 12 feet it will not have so great a velocity of outflow to keep it open as in the city reach, unless it be contracted in ratio to the quantity of water flowing through it. Such contraction, however, would diminish the tidal basin that helps the channel along the city.

This Board do not think it advisable to attempt a greater depth than 12 feet above the Pulp Works, and it will doubtless require expenditures from time to time to maintain even that depth, unless the river is somewhat narrowed above the bend.

BAR AT THE MOUTH OF CHRISTIANA RIVER.

Major Bache's chart (1835) shows a bar in the Delaware, just beyond the mouth of the Christiana, with 8.7 feet depth upon it in its shoalest place at low-water. In other words, the depth of water in the Christiana is not carried out into the Delaware, but shoals above the bottom of both streams to a depth of less than 9 feet. Colonel Macomb, in his report of January 7, 1881, states the natural depth of water on this bar to be from 8 to 9 feet. To remove this bar, or rather to maintain the depth dredged through it, he recommends the construction of à jetty on the north side of the channel of entrance to the river, to be commenced at the shore-line near the light-house, and to be extended about 1,800 feet in a southeasterly direction, as indicated in yellow color on his chart, to the 15 foot bottom curve of the Delaware River. The letter of the Chief of Engineers, referring this subject to us, calls especially for an opinion upon "the advisability of the proposed jetty as the means of securing a permanent improvement at the mouth of the river, as also upon its location, plan, and manner of construction."

The chart of Cherry Island Flats, Delaware River, published in Chief of Engineers' report for 1879 (page 436), exhibits the bottom 18 and 12 foot curves in direction and position opposite mouth of the Christiana, about the same as they would be if this latter river did not pour its waters into the former, their scouring effect apparently not extending out beyond the 10-foot bottom curve of the Delaware River. It seems, therefore, that beyond the low-water line of the Delaware, the waters of the Christiana are not sufficiently concentrated to preserve its channel depth. To secure a depth of 15 feet will require the scouring effect to be extended to the 15-foot curve of the Delaware, and will therefore necessitate a greater concentration of the outflow of the Christiana. It seems probable that a jetty on the north side of the channel may produce that effect, from the fact that the mouth of the Christiana has a direction obliquely up stream in reference to the Delaware. The outflowing waters will therefore be pressed against the dike and be kept concentrated, so as to cause the required erosion. But the old plans show from 8 to 10 feet of water only at low-tide in the current crossing along the river reach from the light-house inward for a distance of 1,300 feet. It seems, therefore, essential that this reach should be contracted by a dike between high and low water on the south side. Besides helping to preserve the channel-depth opposite to itself, this dike will force more of the outflowing current over against the north jetty. It will also concentrate the inflowing tidal waters and prevent the wash of material over the shoals into the river mouth.

The north jetty, as described by Colonel Ludlow, assistant to Colonel Macomb, is to be formed of two rows of oak piles separated an average distance of about 12 feet, the piles in each row to be driven as closely as they can be, and to be bolted to string pieces placed on the inner side, near their upper ends. Cross-timbers will bind the two rows of piles together. The space thus inclosed, filled with stone rising 4 feet above low-water level, will constitute the jetty. The outer end is designed to be 25 feet square, and suited to receive a beacon-light. This jetty, as above described, if the piles are well driven, will doubtless be strong enough to resist all ordinary pressure to which it may be exposed; but an unusual ice movement would injure it very seriously, and possibly sweep it away. Captain Ludlow, however, states that the ice of the Delaware grounds along the shoal shore, and that its movement in a way to destroy the jetty is not to be apprehended. It seems that piles and timbers of oak have been selected as more durable than pine in that portion of the structure which rises above low-water, and is for a part of the day exposed to air and changes of temperature, inducing slow decay. It is our opinion that it would be better to terminate the pile structure as near the ordinary low-water level as economy of construction will admit, and to put on a superstructure of crib-work rising to high-water. This last, when decayed, can be renewed. The width to resist all pressures to which the jetty may be exposed ought, we think, to be equal to the height throughout.

On accompanying chart (No. 1) is marked a general position in red (A B) for the dike on the south side of the Christiana, at the mouth of the river, proposed by us for reasons already assigned. We do not recommend, however, that the dike be commenced until the effect produced by the jetty in the channel, both outside and inside of Light-house Point, is determined.

This Board has expressed an opinion that the jetty designed by Colonel Macomb to be built on the north or up stream-side of the channel of entrance will probably be efficient in deepening that channel, by reason of the peculiar conformation of the mouth of the Christiana River, by which the outflowing water will be held to the jetty at least for a good portion of its length. Still, we desire to say that in ordinary cases the lower or down stream side of the channel seems to us to be the proper position for such jetty, for the outflowing waters of the tributary will, by the down current of the main stream, be pressed against the jetty to scour a deep channel. The Christiana does not enter the Delaware in a direction favorable for a south-side jetty. To assimilate it to conditions more favorable requires the construction of a short jetty from Light House Point on the north side of the channel, and to bring out the receding south shore by a parallel dike to guide the waters of the tributary into the main river in a proper direction. This south dike, prolonged with an inclination down stream to deep water, would, by aid of the pressure of the outflowing current of the Delaware, hold the ebb of the Christiana in a channel along the dike, and thus produce the required depth of water. The only question in this connection seems to be whether the Delaware current is strong enough to prevent the Christiana waters from spreading after passing the outer end of the north jetty. If the current be moderately strong there can be no doubt that this project will be successful.

It will, however, require a greater length of dikes, and consequently be more costly than the project submitted by Colonel Macomb. We do not, therefore, urge its adoption in this locality, not economically favorable to its application, for reasons already set forth. Colonel Macomb's project, however, has the objection incident to all up-stream jetties, that of building out the up-stream shore in process of time, and thus necessitating its own extension, to be followed by the prolongation of the south dike, represented in this case by line A B, sketch 1, accompanying.

In conclusion, this Board concurring generally in opinion with Colonel Macomb, recommends the construction of the north dike proposed by him out to the 12-foot bottom curve of the Delaware during this working season, and the excavation of a 12-foot channel to the Pulp Works, to be followed next spring by a sufficient number of soundings on the river to determine where deposits take place and where scouring occurs. From such a survey, compared with that of 1880, a project for the further improvement of the Christiana can be arrived at, based upon more full and satisfactory information than is now available. All projects will, however, to some extent be inefficient if the drainage of the city of Wilmington, so far as solid material is concerned, be not cut off from the river.

Respectfully submitted.

Z. B. TOWNER,
Colonel of Engineers and Bvt. Maj. Gen., U. S. A.
JOHN NEWTON,
Colonel of Engineers, Bvt. Maj. Genl.
HENRY L. ABBOT,
Lieutenant-Colonel of Engineers, Bvt. Brig. Gen.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

F 10.

IMPROVEMENT OF BROADKILN RIVER, DELAWARE.

The present status of the Broadkiln improvement is fully set forth in the accompanying reports dated January 6, January 29, and July 6, 1881.

It appears from these that the most serious obstruction to the present and future navigation is found at the entrance, where there is a low-water depth of less than 1 foot across a broad expanse of sand shoal, and that the only method of securing an improved entrance is to cut through the beach and control the effluent water by means of a dike.

The total expense, including the removal of shoals in the river, is $51,500, the entrance costing not less than $41,000 if the dike be prolonged, as will eventually be necessary, to the 6-foot low-water curve in the bay.

A valuable improvement can, however, be effected by making the cut through the beach and temporarily terminating the dike at low-water mark.

The cost of this will be $25,000, leaving, after deducting the present balance of $9,000, a further sum of not less than $16,000 to be appropriated before any advantageous commencement of the work can be made.

This work is in the collection district of Delaware, and Wilmington is the nearest port of entry. The nearest fort and light-house are, respectively, Fort Delaware and Delaware Breakwater light.

Total amount appropriated to June 30, 1881	$20,000 00
Total amount expended to June 30, 1881	11,022 42
Total present estimated cost of project	51,500 00

Money statement.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		1,022 42
July 1, 1881, amount available		8,977 58
Amount (estimated) required for completion of existing project		41,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		16,000 00
Required in addition to amount available July 1, 1881.		

REPORTS OF COL. J. N. MACOMB, CORPS OF ENGINEERS.

1.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., January 6, 1881.

GENERAL: I have the honor to forward herewith the results of an examination of Broadkiln River, Delaware.

The original survey of this stream for purposes of improvement was ordered and made in 1872. Colonel Kurtz's report and project are found in the Annual Report Chief of Engineers, 1872, pages 791 and following.

The estimated cost of the improvement, to obtain a 6-foot low-water navigation, into and up the river, amounted to $80,447.

In March, 1873, an appropriation of $10,000 was made, and expended during the succeeding fiscal year in dredging upon various shoals between Milton and a point near the mouth, so as to secure a low-water channel at 5 feet deep and 35 feet in width; $30,000 were asked for beginning the improvement of the entrance, but no further appropriation has since been made until that of $5,000 in act of June 14, 1880, of which, after deducting cost of the present re-examination, there remains available a balance of $4,000.

The normal capacity of the Broadkiln navigation is about 5 feet at low-water, and the expense of obtaining this from inside the entrance to Milton is, according to the present estimate, $6,550.

The great difficulty is the entrance, which presents the features common to most minor streams discharging into tide-water through sand beach, of a shallow mouth, undergoing changes, more or less constant, in position and direction.

The trend of the shore is northwest, and that portion of the bay into which the Broadkiln discharges faces the northeast and is exposed to the heavy storms from that quarter.

The Broadkiln is joined near the beach by Lewes Creek, coming down from the south and east nearly parallel to the coast, and the combined current of the two has gradually forced its way northward, extending the narrow peninsula of sand separating the common waters from those of the bay.

A comparison of the present chart of the entrance with that of the Coast Survey of 1842, shows that the peninsula below the junction has prolonged itself northward 4,500 feet, double its length at the earlier date, being an annual advance of about 120 feet. This advance appears to have affected the regimen otherwise in no important degree, the depth at the entrance remaining about the same, namely, 1 and 2 feet at low-water, and the same confusion and contortion of curves of depth outside the entrance appearing now as then.

Three projects present themselves for the improvement of the entrance:

1st. To make a cut through the beach near the junction of the two streams.

2d. To cut off the Broadkiln below the junction and to make a new entrance at some suitable point up Lewes Creek.

3d. To make the new entrance below the junction.

The principal objections to the first plan are that the beach at this point is wide, increasing the amount of material to be removed, and that the discharge from Lewes Creek would press against the new outlet at right angles.

The main objection to the second plan is that each stream would directly oppose the discharge of the other in the immediate vicinity of their common mouth, and the maintenance of a suitable depth on the bar be rendered doubtful. The third project intercepts the two streams after their united waters have assumed a regular movement and by means of a curved dike deflect them into the bay without conflict.

In the matter of final cost it is probable that there would be little to choose among the three, and in considering how to combine, doing the least violence to the settled habits of the two streams, with the promise of securing an improved entrance measurably free from the seeds of future complications, I am of opinion that the third project shown on the chart presents the most favorable conditions.

The construction of the deflecting dike is estimated to cost about $19,500.

The dredging estimate is probably in excess of present requirements. It is based upon securing a low-water area approximately the same as that above the dike, but the substitution for one of the banks of the dike along which, from its curvature, the channel would form, should reduce somewhat the width necessary to secure the desired depth. It is probable that the dike will maintain along its length a channel with a low-water depth of about 6 or 7 feet, and a depth outside of about 4 feet. At high-water, therefore, a vessel drawing 8 feet could probably gain admittance. It is to be observed that the estimate for dredging to 5 feet low-water in the river is based upon the present low-water plane.

The difference between this plane near the junction of the two streams and that in the bay is now about 1 foot, due to the distance of nearly 2 miles to the mouth and the obstructions there.

With an improved entrance a greater drainage from the river, and therefore a lowering of its low-water plane, would be effected, necessitating an addition to the dredging estimate in the river above.

The total of the estimate given in the recapitulation is therefore probably not in excess of what will be necessary.

RECAPITULATION.

Dredging in river, 13,100 cubic yards, at 50 cents per yard	$6,550
Dredging for new entrance, 84,639 cubic yards, at 30 cents per yard	25,400
Jetty at new entrance, 2,600 feet, at $7.50 per foot	19,500
	51,450

Very respectfully, your obedient servant,

J. N. MACOMB,
Colonel of Engineers.

The CHIEF OF ENGINEERS, *U. S. A.*

2.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., January 29, 1881.

GENERAL: I have to acknowledge receipt of department letter of 28th instant, relating to the Broadkiln River (Delaware) improvement and desiring me to state the proposed application of the available appropriation, in case the project recommended in my letter of 6th instant be approved.

The appropriation made in river and harbor act of 1880 for the Broadkiln was $5,000. Of this, after deducting expense of re-examination and survey of the mouth, there remains a balance of $4,000.

The original estimated cost of this re-examination, as given in my letter of July 2, 1880, was $600. The actual cost was $1,000, the excess being due to two causes: first, the somewhat extended examination of the entrance necessary to acquire a clear idea of the existing conditions and the means of modifying them; and, secondly, the unhealthfulness of the locality, the senior assistant being much affected thereby, and the junior assistant, a graduate of the University of Pennsylvania and a very promising young man, dying suddenly of typhoid-malaria.

The application of the existing balance of appropriation depends upon whether or not additional appropriation shall be made.

The main obstruction to the use and navigation of the river is at the entrance, which is also the most costly part of the improvement, the necessary dredging being estimated at $25,400, and the cost of the jetty at $19,500, making a total of $44,900.

Should such appropriation be made as would insure the completion of the entrance improvement, and warrant the expectation that it could be completed in two seasons, I should recommend that the funds be so applied. If such appropriation be made as with the available balance would only suffice to effect the improvement of the river proper, that probably should be its application; and if no appropriation be made, the existing balance might be expended in improving the navigation of the stream to the greatest extent practicable by removal of the more important obstructions.

Very respectfully, your obedient servant,

J. N. MACOMB,
Colonel of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

3.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., July 6, 1881.

SIR: I have the honor to submit the following report and recommendations with reference to the improvement of Broadkiln River, Delaware, for which an appropriation of $5,000 was made in the river and harbor act of March 3, 1881.

The original reports on this stream were made by Lieutenant-Colonel Kurtz and Captain Brown, Corps of Engineers, under date of September 11, 1872, and printed in Annual Report, Chief of Engineers, 1872, page 791 and following.

The project for the improvement contemplated the removal of the shoals and other obstructions to a depth of 6 feet at low-water, and especially the construction of a new entrance through the cape or spit of land lying between the lowest reach and the bay.

The total estimate was $80,447, of which the necessary works for the entrance would cost $30,000.

The appropriation, based upon this project, made in 1873 was $10,000 only, and failing a sufficient sum to complete the improvement of the entrance, this amount was expended in dredging the more important shoals in the river.

No further appropriation was made until that of June 14, 1880, of $5,000.

The considerable interval that had elapsed rendered a re-examination necessary, report upon which was made from this office under date of

January 6, 1881, accompanied by charts and an estimate for the improvement, amounting to $51,450.

The recent act of March 3, 1881, contains a further appropriation of $5,000, which, with the preceding one, after deducting cost of survey and necessary expenses, leaves a balance now available to the credit of the work of $9,000.

The accompanying tracing shows the works proposed for the improvement of the entrance, differing from those transmitted with report of January 6, 1881, only in the slightly changed position and greater curvature of the jetty. The objects of this change are to reduce as much as possible the total length of the jetty, and to permit of its reaching the shore line of the bay approximately at right angles thereto; thence curving somewhat eastwardly with the view of securing partial shelter from the northeast gales.

An estimate has been made of the probable least amount that can be used advantageously in making the entrance.

The jetty complete, at an average of $8.50 per running foot, will cost	$15,300
Adding contingencies	1,500
The total cost will be	16,800
Dredging to obtain 6 feet at low-water through new entrance will cost, for 85,000 cubic yards	24,200
Total	41,000

This amount can be reduced temporarily by omitting that more costly portion of the jetty which projects into the bay, and by attempting to obtain by dredging 5 feet at low-water only, instead of 6 feet, with the understanding, however, that the ultimate completion of the jetty and the additional dredging will be required.

The partial works suggested have this advantage, that, while falling short of securing the full results desired, they will effect a very considerable and valuable relief to navigation, semi-permanent in its character, at a cost largely reduced from that of the complete project.

It will represent, in other words, about one season's work. The estimated cost is as follows:

For a dike or jetty from the left bank of Broadkiln through the beach terminating at low-water mark, 1,200 feet, at an average cost of $6	$7,200
Dredging a width of 200 feet from 5 feet at low-water inside to 5 feet in the bay, 60,000 cubic yards, at 25 cents	15,000
Contingencies, &c	2,800
	25,000

The jetty will intercept the outflow from Broadkiln and Lewes Creek, and direct it in a constant channel through and at right angles to the beach.

It is expected that a low-water depth of 3 to 3½ feet will be attained by these means, and prepare the way for the subsequent completion of the jetty and the securing of 6 feet. The low-water depth does not at present exceed 1 foot.

The present balance to the credit of the work is $9,000, which deducted from $25,000 leaves a further amount of $16,000, which is needed to complete this partial project. It is, therefore, recommended that no immediate application of the existing balance be made until Congress shall decide whether or not the additional amount needed shall be appropriated,

Careful consideration has been given to this subject, aided by a full conference with those interested in the navigation. I am assured that, having in view the predominating importance of securing as good an entrance as practicable, this recommendation is in accord with the wishes of the promoters of the project.

Very respectfully, your obedient servant,

J. N. MACOMB,
Colonel of Engineers.

The CHIEF OF ENGINEERS, U. S A.

F II.

IMPROVEMENT OF MISPILLION CREEK, DELAWARE.

The improvement of Mispillion Creek began with an appropriation of $3,000 in act of March 3, 1879, in pursuance of reconnaissance and report printed in Annual Report Chief of Engineers, 1879, pages 467 *et seq.*

The estimates of cost of the projected improvement, like others made at that time, were found to be too small, the subsequent contract prices for dredging being 35 and 45 cents, exclusive of cost of supervision, as against the 30 cents in the original estimate.

The improvement was begun near the head of navigation, and with the $3,000 appropriated in 1879, and the $4,000 of June, 1880, work has since proceeded downward, dredging the shoals successively and making a channel 40 feet in width and 6 feet deep at mean low-water. The Annual Report for 1880, page 588, presented a revised estimate of the cost of continuing the improvement and upon the basis of the 35-cent contract price of 1879, computed the amount necessary to complete the 6-foot low-water navigation in the creek to the entrance, at $10,000. With the $4,000 available July 1, 1880, contract was made in August, 1880, with the American Dredging Company, the price being 45 cents per cubic yard, an increase of 30 per cent. over that of the previous year.

Dredging began in October and continued until December 6, 7,580 cubic yards of mud and gravel having been dredged, and about 4,200 feet of distance covered by the season's operations, carrying the 6 by 40 foot channel nearly down to the upper end of the Mushpot Shoal.

There remain to be dredged the localities and amounts given in the following table:

Locality.	Length.	Present depth.	Proposed depth.	Cubic yards.	Material.
	Yards.	*Feet.*	*Feet.*		
Pasley's to Fork Shoal	950	4.0	6.0	5,700	Mud.
Fork to Reed's Shoal	1,400	4.5	6.0	9,000	Mud and gravel.
May Shoal	300	4.5	6.0	2,500	Gravel.
New Wharf Shoal	150	4.0	6.0	1,250	Gravel and mud.
Willows Shoal	200	5.0	6.0	850	Gravel.
Red House Shoal	200	4.5	6.0	1,650	Gravel.
Flat Reach	230	5.0	6.0	1,500	Mud.
Total	3,430	....	....	22,450	

which, at 45 cents per cubic yard, will cost $10,000.

It will be observed that the increase in cost from 35 to 45 cents nearly balanced the amount of the appropriation and left the same sum to be again estimated.

With the $3,500, appropriated in act of March 3, 1881, contract was made in June, 1881, with Frank Pidgeon, jr., at 43 cents per cubic yard, for continuing work during the ensuing year. A further sum of $6,500 is needed to complete the 6-foot low-water navigation to the mouth.

The act of March 3, 1881, also directed that a survey should be made of the Mispillion entrance with a view of preparing a project for its improvement. The necessary examination will be made during the ensuing season, and the report submitted as soon thereafter as practicable.

It is proper to invite attention to the uncertainty that always exists with regard to cost of dredging by contract, and the frequent high prices it is necessary to pay for such work, especially in small streams and when the amounts of appropriation are limited.

The contract prices obtained do not depend upon any estimate of the actual cost of the work so much as upon the engagements of the contractors and the presence or absence of competition.

There is no remedy that can be applied if the improvements are to go on other than the possession by the United States of a certain amount of dredging plant that can be used for the benefit of those works for which extravagant prices are asked, and which could be kept in operation with marked advantage in reducing cost of work during the entire season.

Mispillion Creek is in the collection district of Delaware, Wilmington being the nearest port of entry. The nearest fort and light-house are, respectively, Fort Delaware and Mispillion Creek light.

Total amount appropriated to June 30, 1881	$10,000
Total amount expended to June 30, 1881	7,000
Estimated cost of improvement	17,000

Money statement.

July 1, 1880, amount available	$4,000 00	
Amount appropriated by act approved March 3, 1881	3,500 00	
		$7,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,000 00	
July 1, 1881, outstanding liabilities	48 28	
		4,048 28
July 1, 1881, amount available		3,451 72
Amount (estimated) required for completion of existing project		6,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		6,500 00

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, at 12 o'clock m., August 7, 1880, for dredging in Mispillion Creek, Delaware.

No.	Names of bidders.	Residence.	Dredging.	Remarks.
			Per cu. yd.	
1	John Van Patten	Hudson, N. Y	$0 49	
2	American Dredging Company	Philadelphia, Pa	45	Lowest bidder.

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, Philadelphia, Pa., at 12 *o'clock m., June* 6, 1881, *for dredging shoals in Mispillion Creek, Delaware.*

No.	Names of bidders.	Residence.	Price per cubic yard.	To commence.	To complete.
1	Frank Pidgeon, jr	Philadelphia, Pa	$0 43	Dec. 1, 1881	June 30, 1882
2	American Dredging Company	Philadelphia, Pa	45	Dec. 15, 1881	April 1, 1882

Abstract of contract entered into by Col. J. N. Macomb, Corps of Engineers, during the fiscal year ending June 30, 1881, *for improvement of Mispillion Creek, Delaware.*

Name of contractor.	Residence.	Dredging.	Date of contract.	Remarks.
American Dredging Company.	Philadelphia, Pa	*Per cu. yd.* $0.45	August 26, 1880	Completed December 6, 1880.

F 12.

IMPROVEMENT OF DUCK CREEK, DELAWARE.

The original examination of this stream was made in 1878, and the report, dated December 3, 1878, appears in the Annual Report Chief of Engineers, page 470 *et seq.*

In this paper especial importance was attributed to the improvement of the entrance, on account of the evident desirability of harbors for the use and safety of the numerous small vessels engaged in fishing, oystering, and freighting that navigate the broad reaches of Delaware Bay.

The Duck Creek entrance offers natural advantages superior to those at most other points on the Delaware coast.

For the purpose of dredging a channel through the bar, the estimate was $5,000, putting the cost of dredging at 20 cents per cubic yard. The act of June 14, 1880, appropriated this sum specifically for the entrance, and, after a more careful survey had been made, the work was put under contract early in September to the lowest bidder at 26½ cents per cubic yard.

The distance from 8-foot water in the mouth of the creek to the 8-foot low-water contour in the bay, was found to be 600 yards, with an average depth over the bar of 4 feet. The channel, as projected, was to be 8 feet deep, with a width as great as practicable, not less than 100 feet. The work proved to be more difficult than was anticipated. The dredgings being deposited in the bay, the dredge necessarily worked outside the bar. The locality was much exposed and fresh water for steam purposes was brought from a distance up the creek. The material, instead of being principally mud and sand, was found to be largely a stiff clay, much more expensive to handle, although its tenacious character gave greater promise of permanence of the deepened channel.

The expenses of supervision, &c., added to the contract price, made the cost of the work about 32 cents, over 50 per cent. greater than the 20 cents originally estimated by the assistant engineer, before experience of such dredging. The amount of dredging practicable with the appropriation was, therefore, correspondingly reduced, and the result of the work, which closed in November, was a channel 8 feet deep with a width of 50 feet for a greater portion of its length, and 25 feet only for the remainder.

January 24, 1881, report of the facts was made to the Department, and a revised estimate submitted, based upon previous experience.

For the completion of the dredging work at the entrance, the estimate was $7,500, and for the removal of shoals in the creek, $11,500, making a total of $19,000. The act of March 3, 1881, appropriated a further sum of $3,000. Contract was made near the end of June for expending this amount in widening the existing channel to as great an extent as the funds would permit. The work will be executed during July and August, 1881. A further sum of $4,500 is required to complete the enlargement of the channel to the 100 feet originally projected.

It seems probable, notwithstanding the stiff material through which the channel is made, that some additional protective works will be hereafter required in order to prevent the lighter sand and mud set in motion by the waves and tidal currents of the bay from filling the cuts.

In nearly all such cases the assistance of a curved jetty extending from the shoal, usually on the up-stream side of the creek (in order not to interfere with the free entrance of the flood-tide), is indispensable to concentrate and direct the outflow from the creek and prevent loss of scouring force by spreading.

Future observation must be depended upon for the determination of this question with reference to Duck Creek.

Duck Creek is in the collection district of Delaware, its nearest port of entry being Wilmington, Del. There is a light-house at the entrance to the creek, and Fort Delaware is the nearest fort.

Total amount appropriated to June 30, 1881	$8,000 00
Total amount expended to June 30, 1881	4,998 11
Total estimated cost of improvement	19,000 00

Money statement.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$8,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,998 11	
July 1, 1881, outstanding liabilities	88 96	
		5,087 07
July 1, 1881, amount available		2,912 93
Amount (estimated) required for completion of existing project		16,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883:		
For the entrance	$4,500 00	
For the creek proper	11,500 00	
		16,000 00

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, at 12 o'clock m., August 26, 1880, for dredging in Duck Creek, Delaware.

No.	Names of bidders.	Residence.	Price per cubic yard.	Commence work.	Complete work.	Remarks.
1	G. H. Ferris	Baltimore, Md.	$0 27	November 1, 1880.	July 1, 1881.	
2	John Van Patten	Hudson, N. Y.	27.4	At once	November 20, 1880.	
3	American Dredging Company.	Philadelphia, Pa.	29½	Within 10 days.	November 30, 1880.	
4	Frank Pidgeon, jr	New York City	26½	November 10, 1880.	March 30, 1881.	Lowest bidder.

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, at 12 m., June 27, 1881, *for dredging at the mouth of Duck Creek, Delaware.*

No.	Names of bidders.	Residence.	Price per cubic y'd.	Commence work.	Complete work.
1	Frank Pidgeon, jr.	Philadelphia, Pa.	$0 33	....	Oct. 1, 1881.
2	American Dredging Company.	Philadelphia, Pa.	25	July 15, 1881.	Aug. 20, 1881.

Abstract of contract entered into by Col. J. N. Macomb, Corps of Engineers, during the fiscal year ending June 30, 1881, *for improvement of Duck Creek, Delaware.*

Name of contractor.	Residence.	Dredging.	Date of contract.	Remarks.
Frank Pidgeon, jr.	New York City	*Per cu. yd.* $0 26½	Sept. 1, 1880.	Completed Nov. 17, 1880.

F 13.

IMPROVEMENT OF COHANSEY CREEK, NEW JERSEY.

The improvement of the navigation of Cohansey Creek has been in progress since 1872. The principal obstructions are found within the city limits of Bridgeton, lying at the head of navigation, and are in great part due to the washings of sand and gravel from the slopes and streets into the stream. Precautions have been taken by the city authorities to guard against this in the future.

Other than these shoals at and near Bridgeton, the navigation of the creek, though tortuous, is deep and unobstructed, with a free flow of water and ample rise of tide.

The entrance to the creek is over a wide flat of soft mud, with 5 or 6 feet over it, at low-water. A dredged channel could not maintain itself, and the construction of a long curved dike, extending from the east bank of the creek, would be required to utilize the scour of the currents.

The expenditures hitherto made have been at Bridgeton, where a considerable commerce is localized. The steamer plying between Philadelphia and Bridgeton draws about 7 feet, and this depth has been kept in view.

With the $4,700 available on July 1, 1880, the enlargement of the channel was continued during the summer and fall, under contract with Van Patten.

In all, 10,788 cubic yards were removed from the channel, 4,896 cubic yards being landed above high-water, or as filling behind bulkheads, and 5,892 cubic yards deposited on the shores above low-water, where it would not be liable to be washed back into the channel.

The cost of the two kinds of work, respectively, was 45 cents and 32 cents.

The effect of the improvement is to give a 7-foot low-water channel 60 to 80 feet wide, up to Broad Street Bridge, and between that and Commerce Street Bridge a narrower one of the same depth. At Broad Street Bridge a space was left undredged, in order not to endanger the gas and water pipes of the city, which cross the creek at this point, at a depth of less than 5 feet below low-water. Between Commerce Street and the Nail Works Bridge a shoal was deepened to 4 feet at low-water.

The city authorities intended lowering the pipes obstructing the navigation, but up to this time they have taken no positive action in that direction, with the exception of some futile negotiations with Van Patten to do the work. It is absolutely necessary, if the improvement of this stream is to continue as has been hitherto directed by Congress, that these pipes should be sunk into the bed of the stream to such depth as will admit of obtaining free navigation over them.

The efforts of those interested in the navigation have hitherto been ineffectual in securing the necessary action, the cost of which would represent but a small fraction of the appropriations made from the United States Treasury for the improvement of the navigation.

The available ground for depositing dredgings between high and low-water is nearly exhausted, and the greater part of these hereafter must be landed above high-water. The lower portion of the dredged channel, in assuming a more settled regimen, has evinced a tendency to deposit at several points.

It is proposed to make a re-examination from the upper steamboat wharf to a point half a mile below the lower landing at Bridgeton, for the purpose of estimating the cost of necessary dredging.

Of the $7,000 appropriated in act of March 3, 1881, about $5,000 will be expended on this work, reserving the balance of $2,000 until the matter of the pipes shall have been determined.

There is needed to complete the project a further appropriation of $10,000.

Information has been received from the collector that the data with relation to commercial statistics furnished in last year's report will likewise answer for this year, no change of importance having occurred.

Cohansey Creek is in the collection district of Bridgeton, N. J., which is its nearest port of entry. The nearest fort and light-house are, respectively, Fort Delaware and Cohansey light.

Total amount appropriated to June 30, 1881	$31,000 00
Total amount expended to June 30, 1881	23,997 00
Total estimated cost of the work	41,000 00

Money statement.

July 1, 1880, amount available	4,701 17	
Amount appropriated by act approved March 3, 1881	7,000 00	
		$11,701 17
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		4,698 16
July 1, 1881, amount available		7,003 01
Amount (estimated) required for completion of existing project		10,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		10,000 00

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, Philadelphia, Pa., at 12 o'clock m. August 5, 1880, for dredging for improvement of Cohansey Creek, New Jersey.

Number.	Names of bidders.	Residence.	Dredging.		Remarks.
			Deposit material above low-water mark.	Deposit material above high-water mark.	
			Per. cu. yd.	*Per. cu. yd.*	
1	John Van Patten	Hudson, N. Y	$0 32	$0 45	Lowest bidder.
2	Lincoln G. Ferris	Baltimore, Md	40	70	
3	American Dredging Company.	Philadelphia, Pa	83	48	

Abstract of contract entered into by Col. J. N. Macomb, Corps of Engineers, during the fiscal year ending June 30, 1881, for improvement of Cohansey Creek, New Jersey.

Name of contractor.	Residence.	Dredging.		Date of contract.
		Deposit material above low-water mark.	Deposit material above high-water mark.	
John Van Patten	Hudson, N. Y	*Per. cu. yd.* $0 32	*Per. cu. yd.* $0 45	August 19, 1880.

F 14.

IMPROVEMENT OF SALEM RIVER, NEW JERSEY.

Salem River is an affluent of the Delaware, discharging through Salem Cove by means of a 6-foot mean low-water channel.

At a bend in this channel, near the entrance to the river, a bar of sand, gravel, clay, and small bowlders obstructed the passage of vessels. The project for the improvement consisted in dredging through this bar to the depth of 8 feet at mean low-water.

The annual report for 1880 proposed with the appropriation of $3,000 of June 14, 1880, to increase the width of the dredged cut, which averaged 65 to 70 feet, to about 110 feet, which would suffice for the requirements of the existing navigation.

Contract was made with the American Dredging Company at 40 cents per yard, and the work completed in October, 1880, with the result of obtaining a channel with an average width of 100 feet. It is not supposed the 8-foot channel will retain its depth, but the banks and bottom will be of sand and mud instead of clay and bowlders.

The act of March 3, 1881, appropriated a further sum of $3,000 for improving Salem River, New Jersey.

It appeared from the representations made from the locality that this appropriation was not intended for the work hitherto in progress, and which the operations above reported completed, but for the improvement of a stream which formerly constituted the upper part of Salem River, but some years ago had been divided therefrom by a dam, and furnished with a separate outlet by means of a canal, 1½ miles long, leading directly to the Delaware, in the vicinity of Deep Water Point.

The river and harbor act of 1878 directed an examination of the stream under the title of "Salem River, New Jersey, between Sharpstown and the Delaware Canal," and the report was printed in Annual Report of the Chief of Engineers, 1879, pages 474, *et seq.*

It was shown that for a thorough improvement of the navigation there were required, 1st, the deepening and protection of the mouth, viz, the canal entrance; 2d, the enlargement of the canal itself, which had been originally constructed with too contracted a cross-section; and, 3d, the removal of shoals in the stream proper.

The cost of the first and second items was too large for consideration with the funds available. The main obstruction in the creek, between the canal and the head of navigation at Course's Landing, was a 3 to 5 foot low-water shoal near Biddle's Landing. Two other small shoals existed, one in the canal, the other near Webber's Landing.

Contract was therefore made for the removal of these shoals by dredging to the depth of 6 feet at mean low-water, and a practicable width of 50 to 60 feet, which will answer all present requirements.

The work will be completed during the ensuing season.

A further sum of $1,500 will complete the improvements if appropriated for the fiscal year ending June 30, 1883.

Salem River is in the collection district of Bridgeton, N. J., which is the nearest port of entry.

Fort Delaware is the nearest fort, and the Finn's Point range-lights the nearest light-house.

Total appropriations to June 30, 1881	$13,000 00
Total expenditures to June 30, 1881	9,972 86

Money statement.

July 1, 1880, amount available	$3,000 00	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$6,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,972 86
July 1, 1881, amount available		3,027 14
Amount (estimated) required for completion of improvement		1,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		1,500 00

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, at 12 o'clock m., August 6, 1880, for dredging at the mouth of Salem River, New Jersey.

No.	Names of bidders.	Residence.	Dredging.	Remarks.
			Per cu. yd.	
1	John Van Patten	Hudson, N. Y	$0 45	
2	American Dredging Company	Philadelphia, Pa	40	Lowest bidder.

Abstract of contract entered into by Col. J. N. Macomb, Corps of Engineers, during the fiscal year ending June 30, 1881, for improving the channel at the mouth of Salem River, New Jersey.

Name of contractor.	Residence.	Dredging.	Date of contract.	Remarks.
		Per cu. yd.		
American Dredging Company.	Philadelphia, Pa.	$0 40	September 27, 1880	Completed October 22, 1880.

F 15.

IMPROVEMENT OF CHESTER CREEK, PENNSYLVANIA.

The original examination of this stream was made during the last season, in compliance with river and harbor act of June 14, 1880. A copy of the report and project, dated January 4, 1881, which was printed as part of House Ex. Doc. No. 34, Forty-sixth Congress, third session, is forwarded for incorporation herewith.

The total estimate was $10,781 to obtain a channel 7 feet deep at the mouth, diminishing upwards, omitting from consideration the probable rock excavation that would be required in the upper portion of the stream.

The bridge at Third street, 1,575 feet from the mouth, is a permanent structure, affording head room of 7 or 8 feet, only at high-water; fifteen hundred feet further up is that of the Philadelphia, Wilmington and Baltimore Railroad, also a permanent bridge, with head room of 15 feet, and 500 feet further up is still another, the Seventh street bridge, with the same head room.

It will be impracticable by reason of these bridges to operate dredges in these sections of the stream, and if the improvement is to be continued to include them, special appliances must be devised to meet the case.

It was decided to expend the $3,000 appropriated in act of March 3, 1881, between the Third street bridge and the entrance from Delaware River, and contract was made early in July, at 47.9 cents per cubic yard, the work to be completed during the fiscal year 1881–'82. The contract price, with 10 per cent. added for supervision, makes the cost about 53 cents per cubic yard, and admits of dredging about 5,600 cubic yards, This will make a channel 7½ feet deep at low-water and 40 feet wide from the Third street bridge into the Delaware River. The total of the original estimate, less the previous appropriation, is $7,781.

This work is in the collection district of Philadelphia, which is the nearest port of entry, the revenue collected there during past the fiscal year amounting to $11,213,825.44. Fort Mifflin is the nearest fort and the Schooner Ledge range-lights the nearest light-house.

Total amount appropriated to June 30, 1881	$3,000
Total amount expended to June 30, 1881	———

Money statement.

Amount appropriated by act approved March 3, 1881	$3,000 00
July 1, 1881, outstanding liabilities	36 92
July 1, 1881, amount available	2,963 08

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, United States Army, at 12 m., June 27, 1881, for dredging in Chester Creek, Pennsylvania.

No.	Names of bidders.	Residence.	Price per cubic yard.	Commence work.	Complete work.
1	Frank Pidgeon, jr	Philadelphia, Pa	$0 47.9	Nov. 15, 1881	June 30, 1882
2	American Dredging Company	Philadelphia, Pa	60	Nov. 15, 1881	Dec. 15, 1881

SURVEY ON CHESTER CREEK, PENNSYLVANIA.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., January 4, 1881.

GENERAL: I have the honor to submit the following report, accompanied by a tracing of the chart of Chester Creek, Pennsylvania, in accordance with section 2 of the river and harbor act of June 14, 1880.

The creek rises in the range of cultivated hills lying a few miles west from the city of Chester, a place of large and growing population, and the seat of varied and important industries.

The creek passes through the heart of the city, and discharges into the Delaware River. It therefore acts both as a drainage sewer for the city, and by means of the small craft, canal-boats, &c., a valuable feeder as well.

The survey was carried from the mouth to the village of Uplands, a distance of two miles, by means of triangulation and traverse lines. Two tide-gauges were observed, one at the mouth, the other at Bunting's Wharf, half-way to Uplands. A line of levels connected the two gauges, and the slope of the surface at low-water was ascertained to be 0.042, or about 0.038 feet to the mile.

The entrance from the Delaware, in which the tidal range is 6 feet, is over a bar of soft material having between 4 and 5 feet depth at low-water; thence as far as Bunting's Wharf, 5,700 feet, the 6 feet low-water curve occupies the greater portion of the stream. The bridge at Third street, however, is a permanent structure, with limited head room at high-water, and the navigation for masted vessels, therefore, terminates at this point.

The tidal range at Bunting's is 5.9 feet, nearly the same as at the mouth. Between these two points the average low-water width is about 70 feet. Above Bunting's the width and depth decrease considerably, and below Kirlan street bridge, at the village of Uplands, the terminus of the survey, the bed of the stream is bare at low-water. There are some points below Bunting's where the existence of rock in the creek bed is indicated by the chart, viz, 300 feet below Third street bridge, 500 feet above Third street bridge, 125 feet above Philadelphia, Wilmington and Baltimore Railroad bridge, 125 feet below Seventh street bridge, 700 and 900 feet above Seventh street bridge, and 200 and 100 feet below Bunting's Wharf; and between Bunting's and Uplands these indications are quite numerous, with frequent exposure of rock and bowlders. It is probable that if the improvement of the upper portion of the stream particularly is undertaken, it will be found necessary to make some rock excavation to secure a channel of the desired width and depth. The nature of the present examination was not such as to afford exact information on this point; to cover which, a careful examination by borings is required.

The project for the improvement of the creek contemplates its division into four sections, with suitable channel dimensions in each, diminishing upward.

SECTION I. *From the mouth to Third street bridge.* Distance = 1,575 feet.

Channel to be 30 feet wide and 7 feet deep at low-water. Amount to be dredged, 2,883 cubic yards mud. Cost, at 35 cents, $1,009.

SECTION II. *From Third street bridge to Bunting's.* Distance = 5,025 feet.

Channel to be 25 feet wide and 6 feet deep at low-water. Material to be dredged, 7,800 cubic yards sand, mud, and gravel. Cost, at 50 cents, $3,900.

SECTION III. *Bunting's to ½ mile above.* Distance = 2,400 feet.

Channel to be 25 feet wide and 4 feet deep at low-water. Material to be dredged, 5,100 cubic yards sand, mud, and gravel. Cost, at 55 cents, $2,805.

SECTION IV. *From end of Section III to Kirlan street bridge.* Distance = 3,100 feet.

Channel to be 25 feet wide and 2 feet deep at low-water. Material to be dredged, 5,111 cubic yards sand, mud, and gravel. Cost, at 60 cents, $3,067.

RECAPITULATION.

	Material.		Price.	Cost.
	Quantity.	Kind.		
	Cub. yds.			
Section I	2,883	Mud	$0 35	$1,009 00
Section II	7,800	Mud, sand, gravel	50	3,900 00
Section III	5,100	do	55	2,805 00
Section IV	5,111	do	60	3,067 00
Totals	20,894			10,781 00

* * * * * * *

Very respectfully, your obedient servant,

J. N. MACOMB,
Colonel of Engineers.

The CHIEF OF ENGINEERS, *U. S. A.*

F 16.

IMPROVEMENT OF RANCOCAS RIVER, NEW JERSEY.

The original report on the examination of Rancocas River, New Jersey, ordered by river and harbor act of June 14, 1880, was submitted January 4, 1881, and printed as part of House Ex. Doc. No. 34, Forty-sixth Congress, third session. A copy of this report is herewith for incorporation.

The survey, which was suddenly terminated in the fall by the early advent of winter, was completed in the spring of 1881.

In order to accommodate the present considerable business of the stream, a mean low-water channel of at least 6 feet depth, with a width of 150 to 200 feet, is required to Centreton, 7¼ miles from the mouth, and the cost of obtaining this navigation is estimated at about $42,000. To carry a 5-foot low-water channel to Mount Holly would require about $40,000 more.

The entrance from the Delaware is naturally good, and the principal obstruction is found about 4 miles above, in the vicinity of Hamill's Island, or "Juan Fernandez Island," as it is termed on the charts of the riparian commissioners of the State of New Jersey.

The cost of suitably deepening and widening the navigation at this point was estimated at $17,000, including the construction of a dike to connect the upper end of the island with the main shore and direct the tidal flow into the channel south of the island.

The act of March 3, 1881, appropriated $10,000 for this stream, and with this amount contract was made July 8, 1881, with the American Dredging Company, at 55 cents per cubic yard, a price considerably in excess of the estimated cost. The contractors, however, agreed in consideration of the acceptance of their offer to include in the contract the construction of the dike without expense to the United States, the intention being to obtain a place of deposit for the dredging. This agreement was made a portion of the contract. The work is to be completed during the present season.

The results anticipated from it are the construction of the dike, and the dredging of a channel 6 feet deep at mean low-water, with a least width of 100 feet, from the 6-foot curves below Hamill's Island to the 6-foot curve above Coate's Bar, a distance of about 800 yards. This channel should be subsequently widened to at least 150 feet, and with the aid of the dike a permanent improvement will probably be effected.

The estimate to carry the 6-foot channel to Centreton, deducting the current appropriation, is $32,000, of which not less than $25,000 should be appropriated for the fiscal year 1882–'83, and can be profitably expended.

This improvement is in the collection district of Burlington, N. J., which is the nearest port of entry. The nearest light-house and fort are Fort Mifflin and Fort Mifflin light respectively.

Total amount appropriated to June 30, 1881	$10,000
Total amount expended to June 30, 1881	131,000
Original cost of project	81,236

Money statement.

Amount appropriated by act approved March 3, 1881		$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$131 00	
July 1, 1881, outstanding liabilities	49 04	
		180 04
July 1, 1881, amount available		9,819 96
Amount (estimated) required for completion of existing project		71,236 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		25,000 00

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, Philadelphia, Pa., at 12 *o'clock m., June* 9, 1881, *for dredging in Rancocas River, New Jersey.*

No.	Names of bidders.	Residence.	Price per cubic yard.	To commence.	To complete.	Remarks.
1	G. H. Ferris	Baltimore, Md.	$0 60	Oct. 1, 1881 ..	July 1, 1882 ..	
2	American Dredging Company.	Philadelphia, Pa.	55	July 20, 1881.	Oct. 30, 1881 .	18 cents if allowed to dump behind Hamill's Island at all stages of tide.

EXAMINATION OF RANCOCAS RIVER, FROM THE DELAWARE RIVER TO PEMBERTON, BURLINGTON COUNTY, NEW JERSEY.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., January 4, 1881.

GENERAL: I have the honor to submit the following preliminary report on the examination of "Rancocas River from the Delaware River to Pemberton, Burlington County, N. J.," required by river and harbor act of June 14, 1880.

The Rancocas enters the Delaware 5 miles above Bridesburg, Pa., and drains an area of about 350 square miles of rich and prosperous agricultural country, containing numerous towns and villages.

The survey was carried up from the mouth to Mount Holly by means of a tier of triangles, resting on a base at Delanco, and checked by a secondary base above. Between Mount Holly and Pemberton the woods press upon the valley, and this portion was surveyed by traverse lines.

Six tide-gauges were established at convenient points. That at Delanco, one mile above the mouth, was observed consecutively for 38 days, the others only during hydrographic work in their vicinity, the observations being corrected by the Delanco gauge.

Owing to the extraordinarily early formation of ice and occurrence of heavy snow-falls, the soundings and connection of the gauges by leveling were not completed by the time it became necessary to recall the field parties, and it was only practicable to obtain the hydrography from the mouth to Mount Holly, with a gap of 2½ miles from Busby's to the Forks, which remains to be closed in the spring.

The condition of the stream, however, over this interval, was carefully observed, and the extent of the obstructions estimated with a fair approximation to accuracy.

In order not to delay this report until the final charting of the field work could be completed, advantage has been taken of the linear data afforded by the official maps prepared for the riparian commission of the State, upon which the soundings have been plotted and the curves of depth drawn. A tracing of these maps is forwarded herewith.

The Rancocas is a stream of good natural capacity, and, as the commercial statistics show, the medium of a heavy traffic, which suitable improvements would increase, according to various estimates, between 50 and 100 per cent.

According to the riparian commission chart, the width at the mouth is about 600 feet between the low-water marks, and the average width to the Forks, 8 miles above, is rather in excess of 400 feet. The embouchure is into deep water in the Delaware, where the tidal range is nearly 6 feet, and a draught of between 7 and 8 feet can be carried in over the bar at low-water. After entering, the 12-foot low-water curve occupies a large portion of the navigation up to Hamill's Island and occasionally reappears above. The first serious obstructions encountered are below Hamill's Island, 3½ miles from the mouth, where the 12-foot curve is interrupted, and at Coate's Bar, a half mile further, which even the 6-foot curve fails to pass. The difficulties in this vicinity are due to two causes, viz, the separation of the river into two channels by Hamill's Island and the interference caused by the discharge from Mill Creek, whose low-water channel has an upward direction, and forms a bar opposite its mouth. A permanent improvement can, in all probability, be effected by the removal of the shoals by dredging and the construction of a *dike* from the upper end of Hamill's Island to the bank above, thereby excluding the river from the channel back of the island and restricting it to more nearly its normal dimensions.

To enable the discharge from Mill Creek to take the proper direction and pass out by way of the back channel, the construction of a new mouth, curving downward, will be desirable.

At six points between Coate's Bar and Centreton, 7¼ miles above the mouth, the channel is either divided or unduly narrowed by bars lying in the stream or extending from the shore. In most of these cases the effect of dredging would probably be largely permanent. In others it is possible that local causes exist that will be discovered and remedied in the course of the improvement. The dredging estimated for will be necessary in any case.

Three-fourths of a mile above Centreton, and 8 miles from the mouth, the river forks; the north branch leading to Mount Holly, Smithville, and Pemberton; the south, and rather the larger branch, to Hainsport, Lumberton, and Medford.

Between the Forks and Mount Holly, 3½ miles in a straight line and 5 miles by water, the stream is reduced to about ⅓ of its width below, with a corresponding loss of depth and power. The average low-water width is about 100 feet.

The tidal range, which at Centreton is nearly 4 feet, is reduced at Mount Holly to about a foot, and the variation is obscured by the greater variations due to the opening and closing of the water power created by a dam above.

Mount Holly is a town of 5,000 inhabitants, the seat of large and varied industries, and the center of a rich farming region. In its upper suburb a dam has been constructed, giving a head of about 20 feet. Below this the stream now has a nearly continuous low-water channel of 2 feet, the deepening of which is regarded as of great importance to the commerce of Mount Holly and the points above.

Between Mount Holly and Pemberton, a distance of 6 miles in a straight line and 9 miles by the creek, the stream becomes still narrower and more tortuous. The hydrography has not been obtained, but to continue the navigation over this portion will require the construction of two sets of locks of 10 feet lift to overcome the rise of the dam.

The existing commerce of the Rancocas is carried on by means of numerous steam and sailing vessels and barges, the draught of which to Centreton is now limited to 6 or 7 feet by the Coate's Bar and the other obstructions. At Centreton are extensive fertilizer works, which import phosphate rock from Charleston. The smallest vessels engaged in this trade carry 300 to 400 tons on a draught of about 10 feet. An increased depth over the bars would enable these cargoes to reach Centreton direct without breaking bulk.

The improvement, therefore, of this portion of the stream is based upon obtaining a certain depth of 6 feet at low-water, and for the north branch between the Forks and Mount Holly, 5 feet at low-water. The amounts at each point and the corresponding estimate of cost are given in the following table:

Estimate of cost of a 6-foot low-water channel to Centreton, and a 5-foot low-water channel to Mount Holly.

Locality.	Distance from mouth.	Material.		Price.	Cost.	Remarks.
		Amount.	Nature.			
	Miles.	*Cub. yds.*				
Hamill's Island Bar	3½	8,745	Sand and mud.	$0 40	$3,498	Calculated.
Coate's Bar	4	25,000	....do	40	10,000	Do.
Dike	4	*700	Timber	5 00	3,500	Do.
Mouth Mill Creek	4	6,000	Sand and mud.	40	2,400	Do.
Below Van Skiver's	5	10,445	....do	40	4,178	Do.
Above Van Skiver's	5½	9,150	....do	40	3,660	Do.
Abreast of Busby's	5½	8,000	....do	40	3,200	Estimated approximation.
Above Joist wharf	6	10,000	....do	40	4,000	Do.
Below lime works	6¾	10,000	....do	40	4,000	Do.
At Centreton	7½	7,000	....do	40	2,800	Do.
Between Forks and Mount Holly	13	100,000	...do	40	40,000	Calculated.
Total					81,236	

* Linear feet.

Table of distances and tidal ranges.

Locality.	Distance in miles.	Tidal range in feet.	Remarks.
Rancocas River mouth			
Delanco (tide gauge)	1	5.3	*Thirty-eight days' observations.*—The observations at other gauges were for shorter intervals and corrected by the Delanco gauge.
Bridgeborough (tide gauge)	3	4.98	
Hamill's Island Bar	3½		
Coate's Bar	4		
Mill Creek	4		
Van Skiver's (tide gauge)	5	4.16	
Busby's	5½		
Centreton (tide gauge)	7½	3.95	
The Forks	8		
Hanies wharf (tide gauge)	10	3.50	
Mount Holly (tide gauge)	13	1.31	Mount Holly is 3½ miles above the Forks in a straight line.
Smithville	15		
Pemberton	22		Pemberton is about 6 miles from Mount Holly in a straight line.

Tide gauges were established and observed at points for which the tidal range is given.

DATA IN RELATION TO BRIDGES ON THE RANCOCAS.

1. The turnpike bridge, crossing the river about 1 mile above the mouth, is a double swing bridge with two openings of 45 feet each.
2. Camden and Amboy Railroad bridge is a single swing with an opening of 30 feet. The bridge is built at a bend in the river, and the pier stands at an angle with the currents, offering much difficulty to vessels passing up.
3. Bridgeborough bridge is a draw sliding along the axis of the bridge. The width of opening is 30 feet.
4. Centreton bridge is a single swing with an opening of 30 feet.

The narrowness of these openings is now a considerable obstruction to river traffic, which the proposed improvement would render relatively much greater.

The width of opening should be not less than 45 feet in the clear, and a greater width would be desirable, up to, say, 60 feet.

* * * * * * *

Very respectfully, your obedient servant,

J. N. MACOMB,
Colonel of Engineers.

The CHIEF OF ENGINEERS, *U. S. A.*

F 17.

IMPROVEMENT OF SAINT JONES RIVER, DELAWARE.

The examination of this stream was made during the summer of 1880, in accordance with section 2, river and harbor act of June 14, 1880.

The report (copy herewith) dated December 31, 1880, was printed as part of House Ex. Doc. No. 34, Forty-sixth Congress, third session.

The estimates of quantities in this report were based upon local representations to the assistant engineer, who made the examination, of the requirements of the commerce.

The vessels trading on the stream draw 5 and 6 feet. There is now a high-water navigation of 6 feet to Lebanon, and 5 feet to Dover. It was thought desirable to increase the depth to 6 and 5 feet respectively, at *low-water*, and so avoid delays. The aggregate required to effect this is considerable, and it is probable that a much less sum would greatly, though not thoroughly, relieve the navigation.

The act of March 3, 1881, appropriated $5,000 for the improvement of Saint Jones River. The inadequacy of the amount led to a careful investigation, with the results as set forth in the accompanying report of July 7, 1881, by Captain Ludlow, submitted with a chart of the entrance made in April, 1881. Attention is invited to Colonel Ludlow's suggestions with regard to the importance and difficulty of securing good entrances to the Delaware streams.

The estimated cost of obtaining a 3-foot low-water entrance, including the jetty, is $35,000, and for a 4-foot entrance, $42,500. Dredging, alone, will effect no useful result.

The further action of Congress with regard to the improvement is awaited.

Saint Jones River is in the collection district of Delaware. Its nearest fort and light-house are respectively Fort Delaware and Mahon's River light.

Total amount appropriated to June 30, 1881	$5,000 00
Total amount expended to June 30, 1881	97 30
Estimated cost of improvement	35,000 00

Money statement.

Amount appropriated by act approved March 3, 1881		$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		$97 30
July 1, 1881, amount available		4,902 70
Amount (estimated) required for completion of existing project		30,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		30,000 00

REPORT OF CAPT. WM. LUDLOW, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., July 7, 1881.

COLONEL: In accordance with your instructions, I have the honor to submit the following recommendations with regard to the improvement of Saint Jones River, Delaware, for which an appropriation of $5,000 was made in river and harbor act of March 3, 1881.

The original report on this stream was submitted with chart under date of December 31, 1880, and printed in House Ex. Doc. No. 34, Forty-sixth Congress, third session.

The present navigation is approximately 6 feet at high-water to Lebanon, 12 miles from the mouth, and thence to Dover, 9 miles, 4 or 5 feet at high-water.

The estimates of the assistant engineer who made the examination were based upon the wishes of those interested in the navigation and had in view an increase of the depth to 6 feet at low-water to Lebanon, and thence to Dover, 5 feet at low-water.

The necessary dredging was put at 33,000 cubic yards for the lower portion, and 50,000 for the upper. Canals to cut off long and tortuous bends were also estimated for, to the amount of 83,000 cubic yards.

The entrance to the creek has but little over one foot, at average low-water across a broad expanse of shoal, the shortest distance to the 3-foot low-water curve being 2,500 feet, and to the 4-foot curve, 3,200 feet, without any definite channel.

The business of the creek is transacted in sailing vessels from 30 to 150 tons, with draughts of 5 to 6 feet, and a small steam propeller of 20 tons and 4 feet draught has occasional occupation. While much relief could be afforded to the sailing vessels using the creek by dredging down the shoals, and especially by making the canals or cut-offs, which would effect a considerable saving in distance and a much greater proportional saving in time, nevertheless the condition of the entrance is such as to forbid the expectation of any appreciable increase in traffic until such improvements shall have been made as would permit vessels to enter and depart with comparative ease and certainty, and warrant the establishments of steam lines.

Under these circumstances a more than ordinarily careful examination into the question of the proper application of the present appropriation of $5,000 has been made, and the fullest possible personal information obtained from those interested in the improvement.

From the first it became apparent that a local conflict of interests and opinion existed, both sides being numerously and actively represented. One wished the improvement of the navigation from Lebanon down, including the entrance, the other urged the extension of the navigation upward from Lebanon to Dover. Both at the recent session of the Delaware legislature secured charters from the State, organizing as improvement companies, with the right to dredge, cut canals, remove obstructions, &c., and to collect tolls from passing vessels after the improvements should have been made.

The Dover Company took the precaution of having also inserted in their charter a provision authorizing them to expend such appropriation as Congress should see proper to make.

To divide the appropriation, either equally or in some ratio to mileage, would effect little or no good to the general business, while an application of it entirely to either portion of the stream would constitute a substantial grievance to the other.

* * * * * * *

The improvement of the entrance is a separate matter. The Delaware streams tributary to Delaware Bay have several characteristics in common.

They are of considerable length as compared with their width, with fair natural capacity, traverse salt marshes near their mouths, and penetrate to the heart of the State. Under favorable conditions they are all, or nearly all, susceptible of being made the vehicles of a valuable business and the outlets for the products of the peninsula.

In almost every case the great obstacle is found at the entrance.

Delaware Bay is an arm of the sea, varying in width from 12 to 30 miles, with the ship-channel traversing its axis. Its entire western border is shallow, and the entrance to nearly every stream is obstructed by broad flats of sand, mud, and clay.

The proper improvement of these entrances is the most important and costly feature of any valuable increase to commercial facilities, while at the same time needed harbors of refuge for the numerous small craft plying in the bay would be provided. The number of these vessels engaged in fishing, oystering, and the transportation of the products of the peninsula is, in the aggregate, very large. It would seem a legitimate function of the general government to appropriate for the creation of suitable entrances, leaving the navigation in the streams to be improved, as heretofore in several cases, by State legislation. The machinery for doing this is both simple and inexpensive. The chartered company raises funds, expends them in improving the navigation, levies moderate tolls on the vessels using the improvements until the projectors have been reimbursed with interest for the original outlay, whereupon the powers of the company are in abeyance until further expenditures shall have been made. The cost of the improvements, therefore, is borne directly by those profiting by it, and being widely distributed and collected in small amounts is paid without being practically felt.

The many times larger cost of securing the entrance could not be provided for in the same way, even were it desirable to do so, and the more difficult engineering questions involved in an effective and economical solution suggest the necessity for greater expert knowledge than is needed for dredging shoals and cutting canals.

The tracing of the Saint Jones entrance herewith shows the hydrographic features of the locality and the means proposed for their improvement.

There is no probability of maintaining a dredged channel through the flats without the aid of a jetty. The daily tidal movements, aided by the action of the waves in the shallow waters, would speedily fill it up. A channel suitable for navigation, with the tides flowing across it, would need to be 200 or 250 feet wide, while the protection afforded by the jetty would justify a reduction in the width by one-half and effect a corresponding reduction in the dredging estimate.

In the matter of depth it is not considered advisable to attempt at first a greater draught than 3 feet at low-water, which, with the 5 feet rise of tide, would enable vessels drawing 8 feet to enter at high-water, and those drawing 6 feet to pass during twelve hours out of the twenty-four.

The estimated cost of the necessary work is as follows:

The jetty, 3,300 feet in length, from the shore to the 3-foot curve can be built for about $8 per foot	$26,400
Dredging to 3 feet at low-water, 100 feet wide, 20,000 cubic yards, at 25 cents.	5,000
Total	31,400
Contingencies	3,600
	35,000

To extend the jetty to the 4-foot curve, with corresponding length of dredging, would cost, in addition to the above, $7,500.

The act of March 3, 1881, directed an examination of the Murderkiln, which discharges into Delaware Bay a short distance below the Saint Jones entrance, and where similar difficulties of ingress and egress exist. The examination will be made this summer.

It is probable that should further appropriation be made for the improvement of the two streams a combination mutually beneficial could be effected.

I respectfully recommend that the expenditure of the $5,000 now appropriated to the credit of Saint Jones River be suspended until further action by Congress.

Very respectfully, your obedient servant,

WILLIAM LUDLOW,
Captain of Engineers,
Bvt. Lt. Col. U. S. A.

Col. J. N. MACOMB,
Corps of Engineers, U. S. A.

EXAMINATION OF SAINT JONES' CREEK, IN KENT COUNTY, DELAWARE.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., December 31, 1880.

GENERAL: I have the honor to forward herewith report and tracing of chart of Saint Jones' Creek, Delaware, in accordance with section 2 of the river and harbor act of June 14, 1880.

Dover, the capital of Delaware, lies at the head of navigation of the creek, 21 miles from the mouth. Thence to Lebanon, a distance of 9 miles, a 5-foot low-water navigation is interrupted by shoals, aggregating some 16,000 feet in length, and requiring the dredging of about 50,000 cubic yards to remove them.

From Lebanon to the mouth is 12 miles. The obstructions to a 6-foot low-water navigation in this distance cover about 2 miles in all, and require the dredging of about 33,000 cubic yards.

The upper section of the stream passes principally through an agricultural region, and is tolerably straight, but the lower section traverses salt meadows, and possesses the tortuous character of streams so situated. These deep sinuosities interfere greatly with navigation, and suggest the desirability of cut-offs, which have in some cases been already made. The making of others is urged by those interested, and estimated for in the report, with an aggregate length of a little over one mile. The saving of distance to be effected thereby is about 4½ miles.

Like nearly all the streams discharging into Delaware Bay from the westward, the depth at the entrance is limited by shoal water, extending broadly into the bay. The distance from the mouth to the 7-foot curve is about 2,400 yards, over which is an average depth of only 2 and 2½ feet.

The construction of a channel through these shoals would be costly, and the nature of the bed is such as not to encourage anticipation of permanency.

Very respectfully, your obedient servant,

J. N. MACOMB,
Colonel of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. W. S. EDWARDS, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., November 20, 1880.

COLONEL: I herewith respectfully submit report and map containing results of the examination of Saint Jones' Creek, Delaware.

The object of the examination was to determine the character and probable cost of the improvements desired, by a reconnaissance on which to found an approximate estimate.

Saint Jones' Creek is a tidal stream, about 40 miles in length, rising in the western part of Delaware and emptying into Delaware Bay, 75 miles below Philadelphia. It drains an area of about 55 square miles, nearly all of which are rich agricultural lands and highly cultivated. The products find markets in Philadelphia and New York by means of the small vessels navigating the stream. Dover, the capital of the State, and a city of 2,500 inhabitants, lies at the head of navigation, 21 miles above the mouth. The creek is 60 feet wide at Dover and 115 at the mouth, with an average width of 75 feet. It is navigable at high-water for vessels of 6-feet draught to Lebanon—12 miles above the entrance—a place of 500 population, and at present the principal shipping-point. Thence to Dover—9 miles—but 5 feet can be carried at high-water. There is a draw-bridge at Florence Landing, 7½ miles from the mouth, and another at Lebanon. These draws have openings of 34½ feet each. Two permanent stone bridges cross the creek at Dover.

For convenience of reference in this report, the creek is divided into two sections:

1st. From Dover to Lebanon; 9 miles.

2d. From Lebanon to entrance; 12 miles.

In the first or upper section, the improvement asked for consists of dredging out shoal places so that 5 feet at low-water can be carried from the wharf at Dover to the Lebanon wharves. These shoal spots are mostly at points where the fast land comes down to the creek, and have been formed by the washing down of the bluffs, and consist of gravel and clay, mixed with mud deposit. The material removed can in most instances be placed on the banks of the creek.

There is altogether a distance of 16,000 feet where, to make 5 feet at low-water and 40 feet in width, or 2 cuts of a dredge, will require an average deepening of 2 feet, or the removal of about 50,000 cubic yards of material. This ought to give a channel from Dover to Lebanon sufficient for towing vessels up and down. The rise and fall of tide at Dover averages about 14 inches, and at Lebanon about 2.5 feet.

SECOND SECTION, FROM LEBANON TO THE ENTRANCE; 12 MILES.

In this section both the dredging of shoals and the cutting of canals to straighten and shorten the navigation are asked for. I give below, in a tabulated form, the names of shoals examined, their present depths, and estimated dredging to make a channel of 6 feet depth and 40 feet width.

Name of shoal.	Depth.	Length.	Bottom.	Amount to be excavated.	Cost at 50 cents per cubic yard.	Remarks.
	Feet.	*Feet.*		*Cub. yds.*		
Pickering's Gravel	4	475	Hard	1,500	$750 00	The price is estimated at 50 cents per yard, being 45 cents for dredging and 10 per cent. additional for contingencies, supervision, &c.
James Island	3½	400	..do	1,500	750 00	
Phosphate Mill	4	600	Sticky	2,000	1,000 00	
White Store	3½	1,000	Gravel	4,000	2,000 00	
Red Granary	4	800	..do	2,500	1,250 00	
Heverin	4	200	..do	600	300 00	
Logan's Landing	4	800	..do	2,400	1,200 00	
Jack's Point	3½	600	Sand	2,300	1,150 00	
Warren's Landing	4	700	Gravel	2,200	1,100 00	
Oyster Rocks	4½	5,000	Hard	14,000	7,000 00	
Totals		10,575		33,000	16,500 00	

The canals desired are—

Name.	Length.	Width.	Depth.	Amount to be excavated.	Cost at 45 cents per yard.	Remarks.
	Feet.	*Feet.*	*Feet.*	*Cub. yds.*		
I. Wharton's Fishery	480	40	10½	$8,000	$3,600 00	The cut of 10½ feet below surface of marsh will give 6 feet at low-water.
II. Cherry Tree	420	40	10½	7,000	3,150 00	
III. Heverin	900	40	10½	15,000	6,750 00	
IV. Logan's Landing	540	40	9½	8,000	3,600 00	
V. Jack's Point	3,240	40	9½	45,000	20,250 00	
Totals	5,580			83,000	37,350 00	

These canals are all through stiff marsh.

THE ENTRANCE.

The distance from the mouth of the creek to 7 feet water in the Delaware Bay is 2,400 yards, with an average depth of 2½ feet, shoaling up in places to 14 inches at low-water. To dredge a 6-foot channel, 75 feet wide, across this flat would require the removal of 90,000 cubic yards of material, at a probable cost of 30 cents per yard, which would amount to $27,000. The material, as far as I was able to judge, is mud, sand, and clay. During the time I was at the mouth of the creek, the weather was so bad that it was impossible to make a thorough examination.

TIDES.

	Feet.
Mean rise and fall at entrance	5.00
Mean rise and fall at Dover	1.20

Difference in time between high-water at Dover and at entrance, 4 hours 30 minutes.

These tides are deduced from 4 days' observations.

Saint Jones' Creek is in the collection district of Delaware. Mahon's River Light is the nearest light-house, and Fort Delaware is the nearest fortification.

* * * * * * *

RECAPITULATION.

Name.	Amount to be removed.	Cost per cubic yard.	Whole cost.
	Yards.		
Upper Saint Jones'	50,000	$0 50	$25,000
Lower Saint Jones', shoals	33,000	50	16,500
canals	83,000	45	37,350
Entrance	90,000	30	27,000
Total			105,850

* * * * * * *

There are now trading on the creek 3 vessels of 125 to 150 tons, of 6 feet draught; 5 vessels of 30 to 125 tons, of 5 feet draught; 1 steam-tug 20 tons, of 4 feet draught.

Very respectfully, your obedient servant,

W. S. EDWARDS,
Assistant Engineer.

Col. J. N. MACOMB,
Corps of Engineers, U. S. A.

F 18.

IMPROVEMENT OF THE SUSQUEHANNA RIVER, PENNSYLVANIA.

The act of June 14, 1880, appropriated $15,000 for improving the north branch of the Susquehanna River, from Richard's Island, an island in the river a few miles below Wilkes Barre, Pa., upwards.

In accordance with that act, which definitely located the place for improvement, an examination was made of the river between the lower end of Richard's Island and Wilkes Barre, in order to determine the character and amount of work necessary to improve the navigation. The survey indicated the following points as needing improvement:

1st. *Near the upper end of Richard's Island* there is a shoal 500 feet long. To deepen it to 3 feet, with a width of 60 feet, requires the removal of 1,500 cubic yards of coarse gravel and small bowlders. The material dredged should be deposited across the head of the channel south of Richard's Island, in order to deflect the current somewhat and avoid too much lowering of the water surface above.

2d. *Foot of Wilkes Barre Island.*—The channel should be dredged 60 feet wide for the distance of 1,000 feet, taking out 2,900 cubic yards of gravel and bowlders, and depositing them on a line from the shore to an exposed field of bowlders to guide the flow.

3d. *Head of Wilkes Barre Island.*—The channel now used is the northern one. It is narrow and crooked, and subject to change. The channel to the south of the island is more direct and stable. To open this 60 feet wide for a distance of 1,000 feet, 3,500 cubic yards of coarse gravel will have to be dredged. In order to prevent too much lowering of the river above, it is proposed to build a dike across the north channel to the height of 1 foot above the present average low-water plane, and ballast it with material dredged from the other channel; the dike to be of two rows of oak-piling, with wales and ties bolted with iron bolts, the top of the ballasting pitched with larger stones, hand-set.

The estimate for the improvement as above projected, is as follows:

Dredging 8,000 cubic yards at 60 cents	$4,800 00
Building 625 lineal feet of dike at $3	1,875 00
Total	6,675 00

This project meeting the approval of the Chief of Engineers (August 26, 1880), after due advertisement for bids, on the 28th of September, 1880, contracts were made in accordance with specifications, and for completion of work on or before December 1, 1880, with two parties, one for dredging at 70 cents per cubic yard, and the other for the dike complete at $2,950—rates somewhat in excess of those estimated, but deemed advantageous to the United States.

Owing to the lateness of the season, the work was much impeded by high water and ice formed in November, stopping the dredging entirely.

The excessively cold winter and late spring prevented an early resumption, and a "June rise" in the river again impeded progress. The times for completion were finally extended, at the solicitations of the contractors, to July 30, 1881, for the dredging, and to July 8, 1881, for the dike. The work under both these contracts will have been completed in July, when the amount appropriated will be almost entirely expended.

The act of March 3, 1881, appropriated $15,000 for continuing the improvement of the Susquehanna River above Richard's Island. In accordance with this last act, it was projected to continue the work upon the river, upward from Wilkes Barre towards Pittston, in like manner to what was in progress below Wilkes Barre. For this purpose the shoals must be dredged down, and, in order to avoid reducing too greatly the head of water, the dredged material should be used in the construction of submerged dikes or deflectors to back the current or direct it into the cuts. This project, with specified particulars as to localities and extent of work, received the approval of the Chief of Engineers June 22, 1881, and the preliminary steps for placing the work under contract have been taken.

The Annual Report, Chief of Engineers, 1880, pages 594–604, gives a full account of the north branch of the Susquehanna, and proposition for its improvement. With this will be found another report from the assistant engineer, who has had immediate charge as resident engineer of the present improvement. It will be seen that the careful survey has been extended up the north branch as far as Pittston. The complete estimate of the cost from Wilkes Barre to Pittston is $48,537.50. The present appropriation of $15,000 will be expended in completion of portions of this improvement. This report is recommended for publication, as including much information as to the capabilities of this river, which, if unpublished, may be lost.

The accompanying paper by Steuben Jenkyns, esq., exhibits the sentiments of the inhabitants of that portion of the State of Pennsylvania where the North Branch of the Susquehanna is the great water course.

Total estimated cost of improvement	$63,537 50
Total amount appropriated to June 30, 1881	30,000 00
Total amount expended to June 30, 1881	7,397 56

Money statement.

July 1, 1880, amount available	$15,000 00	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$30,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	7,397 56	
July 1, 1881, outstanding liabilities	3,257 88	
		10,655 44
July 1, 1881, amount available		19,344 56
Amount (estimated) required for completion of existing project		33,537 50

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, at 12 *o'clock m., September* 8, 1880, *for dredging and constructing dike in Susquehanna River above Richard's Island, Pennsylvania.*

No.	Names of bidders.	Residence.	Dredging.	Constructing about 625 linear feet of dike.	Amount bid.		Totals.	Remarks.
					For dredging.	For dike.		
			Per cu. yd.					
1	Van Loon & Boyd.	Plymouth, Pa...	No bid..	$8 per linear foot.	No bid.	$5,000 00	$5,000 00	
2	John Van Patten.	Hudson, N. Y...	$0 74½	$2,950 complete.	$5,960	2,950 00	8,910 00	Lowest bidder for dike.
3	A. H. Coon & J. V. Mooney.	Kingston, Pa ... Wilkes Barre, Pa	0 70	$4.85 per linear foot.	5,600	3,031 25	8,631 25	Lowest bidder for dredging.

Abstract of contracts entered into by Col. J. N. Macomb, Corps of Engineers, during the fiscal year ending June 30, 1881, *for improvement of Susquehanna River, above Richard's Island, Pennsylvania.*

Names of contractors.	Residence.	Dredging at Wilkes Barre, Pa.	Constructing dike at Wilkes Barre, Pa.	Date of contract.
		Per cu. yd.	*Run. foot.*	
Coon & Mooney....................	Wilkes Barre, Pa.....	$0 70	....	September 22, 1880.
John Van Patten.................	Philadelphia, Pa......	....	$4 72	September 24, 1880.

REPORT OF MR. JOHN H. DAGER, ASSISTANT ENGINEER.

WILKES BARRE, LUZERNE COUNTY, PENNSYLVANIA,
January 4, 1881.

COLONEL: I have the honor to submit the following report on the survey and improvement of the North Branch of the Susquehanna River above Richard's Island, Pennsylvania, as authorized by the river and harbor act of Congress dated June 14, 1880, and for which purpose $15,000 was appropriated.

The improvement desired was a channel not less than 3 feet in depth at a low stage of the river, which usually occurred in midsummer and lasted until the fall rains.

The surveys were at first confined to that portion of the river between Richard's Island and Wilkes Barre, a distance of 2¼ miles. One mile below the latter place lies Wilkes Barre Island. The river between these islands has ample depth, ranging from 5 to 11 feet; a deep pool also exists from Wilkes Barre Island up beyond the city for two-thirds of a mile.

RICHARD'S ISLAND.

Richard's Island is about 1 mile in length and from 600 to 800 feet wide, a portion of it being under cultivation, lies about 12 feet above low-water, is of sandy nature, and skirted and protected by bushes and trees.

Opposite this island, on the north shore, are located several collieries, from the upper one of which culm has been, until very recently, dumped into the river. This, however, has not been practiced sufficiently long to impair the channel as yet, which a continuance of the practice will certainly do. Either water-way passing the head of this island is shallow, being less than 2 feet in depth. The north passage offering the better advantages for improvement, it was determined to deepen the water over this shoal by dredging to at least 3 feet, making a cut 60 feet wide by 500 in length, the material consisting of coarse gravel.

This work forms part of a contract now in progress, and under which the excavated material is to be deposited in the channel on the south side of this island, thereby forming a gravel dam across the same, which will serve to deflect a greater body of water toward the improved channel at low stages.

From Richards Island down to the Nanticoke dam, which is the terminus of the North Branch Canal, some 5 miles, is a deep pool, mainly upheld by this dam.

WILKES BARRE ISLAND.

The portion of this island that has an elevation of 12 feet above low-water is mainly cultivated, and is protected by brush and second-growth timber. It is 800 feet wide at the extreme and about 2,000 feet long. The fall in the river between the head and foot of this island is 1 foot.

The channel lately used by the steamboats passed to the north of the island, deflecting nearly at right angles to the axis of the stream above, was narrow and tortuous. Numerous small islands and bars made its navigation difficult, while the south channel was obstructed by two shoals reaching to the main shore, one at the foot and the other at the head of the island.

Improvements here consist of dredging to a depth of 3 feet, and 60 feet wide, 1,000 feet in length, through the shoal at the foot of this island. The material is very coarse gravel, overlying a tenacious blue clay, and when removed is deposited diagonally outward from the south main shore, thereby maintaining a regular prism to the water flow until a greater depth is reached.

The shoal at the head of this island is in part formed by two bars, having an elevation of about 2¼ feet above low-water, which breaks the stream into several threads, the largest of which it is proposed to deepen. This shoal some years ago was raised and increased by local enterprise, by putting in wicket dam, which assisted in retaining moving material, mainly gravel.

The island dividing the river into two nearly equal parts, the flow at low-water not being sufficient to give a draught of 3 feet, over either channel-way, the boatmen concluded to offer some impediment to the current at either channel offering the best facilities for easy and cheap construction. The south channel was chosen, the dam above referred to put in, and the current deflected to the northward sharply. Dredging through this shoal, the depth and width before mentioned for 1,000 feet in length, giving a direct course to the current, supplemented by the construction of a dike across the north channel, are the improvements adopted at this point.

The dike referred to is of two parallel rows of piles, 6 feet apart in the clear, driven 5 feet in the bottom and projecting 1 foot above low-water plane, well waled and tied, 625 feet long and filled and backed by gravel taken from the new channel and paved with large stones, and will be nearly in a direct line with the course of the river at stages.

All of these works are under contract, each particular one being partly finished. The woodwork of the dike is completed, and the interior is filled with gravel only A rise in the river stopped the dredging November 1, after which the formation of ice prevented resumption.

RECAPITULATION OF DREDGING DONE BY CONTRACT TO DATE.

	Cubic yards.
From Richards Island Shoal	797.5
From foot of Wilkes Barre Island Shoal	1,050.0
From head of Wilkes Barre Island Shoal	701.0
Total	2,548.5
Dike built and interior filled ....feet..	625

ADDITIONAL SURVEYS.

While the improvements were under way the surveys were continued up stream, with a view of ultimately reaching Pittston, as interested parties were desirous of having free navigation at all times between Nanticoke Dam and this city, which is distant about 18 miles.

One side of the river was meandered, and a system of triangulation covered the whole work. A graduated No. 16 steel wire, with tags on it, was used for locating soundings, stretched across the stream between points instrumentally determined. Soundings were taken every 10 feet on ranges as close as necessary to determine the bottom, and were reduced to a plane of low-water, adopted as the mean several seasons' low-waters; a line of levels was run the entire extent of the survey to determine the fall in the river; bench marks were left at various points, generally where water-gauges had been established; borings were made with iron rods, below the bed of the river, to determine whether rock in place existed near the surface about the localities where it was apparently necessary that material would have to be removed; current observations were taken in each pool.

MAPS.

The maps herewith submitted are six in number, and include 11 miles of the river. They are drawn to a scale of 100 feet to 1 inch. The soundings given are reduced to a slope, determined by synchronous readings taken on gauges distributed throughout the entire distance. Contours representing 2-foot planes are shown. The character of the bottom is given, together with the shore topography. The location and record of bench marks are shown. Borings are located and depth given below the river bottom. Current observations are represented by arrows drawn to scale showing distance traversed in a given time.

The water slope, with reference to an assumed datum plane, is plotted to a longitudinal scale of 100 feet to 1 inch, and vertical scale of 1 foot to 1 inch, and under this, in proper place on the same scales, are shown profiles of the bottom of the river at all points where less than 5 feet of water exists.

The location of the dike and channels now in course of improvement are outlined, as well as those proposed hereafter.

Commencing at the bridge at Pittston and going downward, the fall of the river per mile is as follows:

	Feet.
Fall for the first mile	1.413
Fall for the second mile	1.830
Fall for the third mile	2.000
Fall for the fourth mile	4.298
Fall for the fifth mile	1.802
Fall for the sixth mile	0.042
Fall for the seventh mile	0.480
Fall for the eighth mile (Wilkes Barre bridge)	2.460
Fall for the ninth mile	1.078
Fall for the tenth mile (head Richard's Island)	0.300
Two-thirds mile further	0.170
Total fall	15.873

Averaging 1.49 feet per mile. This slope, however, is not by any means a regular one. The greater portion is made up at some half-dozen points, which will be referred to under the head of "present obstructions and proposed improvements".

FEATURES OF THE SUSQUEHANNA RIVER.

The banks of the stream are alluvial and generally about 20 feet high, and on the convex sides of the river, at sharp bends, are terraced, indicating that the current at high stages has accommodated itself for more direct discharge of superfluous water, though for a distance of 1 mile above Wilkes Barre, and again for about 2 miles below Pittston, the south shore of the river hugs closely the bases or spurs of rocky anticlinals, which mainly trend east and west and disappear under the surface. The character of the outcrop, is mostly of sandstone formation.

An examination of the maps discloses the fact already known of streams with gravel bottoms: that there always exist, in such large, deep pools, separated by natural dams or gravel bars, and at these points the greater portion of the declivity in the stream occurs.

These bars or dams are by scour or otherwise sometimes removed, thus destroying the pools above, but more generally they are so compact that by impeding the velocity of the current they give opportunity for additional and increased shoaling, and as this heavy material brought down by freshets does not reach tide-water, but remains in the river bed, it follows that the beds of gravel streams must be continually rising, making new deposits at every flood, thereby frequently turning the thread of the river in a new bed and promoting a change of course.

The velocity of water close to the bed of a stream that will just move gravel 1¼ inches in diameter is given at 3¼ feet per second, so the bottom of a stream like the Susquehanna River is very stable at ordinary stages, but will lack stability in flooded stages, when the velocity is increased beyond that given, modified to the extent to which the river is confined to its banks and no chance afforded for relief from overflow, as from experiments given in shoal waters the bottom velocity is only about one-half of that of the surface.

Through the Wyoming Valley the river is a wide one for any ordinary stage of water to pass, while in extraordinary flow may be from one-half to 1 mile wide. The banks being mainly alluvial are easily abraded.

EXISTING OBSTRUCTIONS WHERE IMPROVEMENTS MAY BE PROPOSED.

These will be considered in order, going up stream, and are in addition to those in progress and yet incomplete heretofore referred to.

The first, called the Gas House Riff, is three-fourths of a mile above Wilkes Barre bridge, is a shoal gravel bar connecting the south shore with a long bar or island in the center of the river. The surface of the river falls in a very short distance, at this bar 2½ feet. It is proposed to materially correct this by dredging a 60-foot channel 3 feet deep through it, 700 feet long. This will require the removal of 2,700 cubic yards of coarse gravel. A part of this material is to be deposited on top and in rear of a shoal extending diagonally out from the south shore of the river to an exposed, small bar in the center of the south passage. This shoal overlies a rock-bed running in range for the proposed dumping at a small depth, and will materially assist in keeping up the present head of water, as well as deflecting the flow in a direct passage.

This work is to be supplemented by a dike 300 feet long across the channel existing between the island and north shore, cutting off this passage for such stage of water as may hereafter be determined.

These two works may not be all that will be required at this point; no calculation is now made for others, but it may be necessary to regulate the flow of water through such improved channel by a series of wing-dams, resolving the channel into chute for some distance.

The next obstruction is called Hillman's Riffle, and is a ledge of rock extending from the south shore in a westerly direction across the river, falling slightly downward as it goes outward, and presenting in mid-river a barrier of about 200 feet in width and 2½ feet below low-water.

Above and below this are deep pools running down to 19 feet in depth, the fall between which is less than 2 inches, and unless the pool below should be materially lowered the removal of surface irregularities would leave but a slight excavation of the rock for a channel as proposed, 3 feet deep, 60 feet wide, and 220 feet long. There will be about 500 cubic yards to be removed from this obstruction.

A mile and a half above and a short distance beyond Forty Fort a long, compact gravel shoal is encountered, the depth of water on it ranging from 1½ to 3 feet. This shoal is almost continuous for 4,800 feet, over which distance there is a fall of almost 2½ feet. There is ample water passing here, if confined to a narrow channel, to support such a one as is proposed, namely, 3 feet deep and 60 feet wide, which will be in detached parts aggregating in length 3,600 feet, a portion of which will be only widening an existing 3-foot channel. The accomplishment of this will necessitate the removal of 11,000 cubic yards of material, all coarse gravel. This shoal extends well up along Culver's Island, which is separated from and lies directly below Monockonock Island, at the foot of which are the bars and riffs known as the Ram's Horn. The channel lying to the north of these islands is not suitable for improvement, is very shoal, the 3-foot contours scarcely appearing at all. This channel it is proposed to cut off above, near the head of the island, and will be noted further on.

The Ram's Horn Riff now under consideration falls quite abruptly 3 feet, the channel below the declivity is very contracted, only 150 feet wide; the riff or dam consists of a small bar of gravel in mid-stream, exposed at low-water, having radiating shoal-arms running to the main south shore, to Culver's Island, and to Monockonock Island; also one running directly up stream, joining a large exposed shoal formed well in toward the island. It is proposed to connect this shoal and island by a dike about 150 feet long; then build another one from the island out to the higher part of the shoal forming part of the riff, which will be about 250 feet long, each of them to be at least 1 foot above the surface of water in the pool above, and, in addition, remove by dredging some 5,300 cubic yards of gravel, opening a channel 1,500 feet long, 60 feet wide, and 3 feet deep, as located on the map.

That the above alone will be very effectual is questionable, and that any improvement at this location will be permanent, without additional costly works, is improbable, nor is it expected that those proposed will be all that will be required, but that other wing dams will be needed in assisting in distributing the fall throughout a longer distance than can otherwise be reached, and also retain the proper depths above. No appended estimates are now given for these.

The next obstruction met with is located at the head of Monockonock Island. The water here falls 1½ feet. The face of the shoal runs from the south shore, at a very acute angle, diagonally across the south channel of the river to the island. Borings were taken on this line, proving the absence of rock, to a depth of 5 feet below surface of our water-plane.

It is proposed to open this shoal by dredging a cut 900 feet long, 60 feet wide, to 3 feet in depth through a coarse gravel bottom, removing 5,500 cubic yards.

In addition, it is proposed to construct a dike across the north channel from the island to the main shore, some 600 feet long, and 1 foot higher than the surface of the main reach above the riff.

The north channel is narrow and shoal at low stages; receives part of its flow from the main stream immediately above the head of Monockonock Island, and part some 1,800 feet above, the interval being separated by a long, narrow gravel shoal, lying almost parallel with the north shore.

This improvement opens into a deep pool reaching, without further obstructions, to Wintermoot Island.

From the foot of Wintermoot Island, half way up it, is found shoal-water. Through this, for 2,200 feet, it is proposed to excavate 5,300 cubic yards of coarse gravel, giving a regular channel of 3 feet in depth and 60 in width. A short distance above, at the head of the island, is found the last obstruction covered by the survey. The surface-water falls 2¼ feet in a distance of 1,700.

This riffle presents a rocky ridge lying along underneath the bar, as it extends diagonally down stream across the river, and at a slight depth below the bottom.

It is possible a good channel may be obtained here, with a very close approximation to the required depth, without the necessity of rock excavation, by removing the gravel and small bowlders down to the rock face.

The dredging, to give the regular proposed channel 60 feet wide and 3 feet deep, will extend for 700 feet in length, and remove 2,700 cubic yards of gravel and 150 of rock.

The closing of the north channel by the island with a dike of 375 feet in length, 1 foot higher than the water-plane above, will add materially to the flow of water through the proposed cut.

It is scarcely possible that this opening could lower the reach above, but if it would no interference by shoaling at other points above would happen, as the pool ranges in depth from 7 to 16 feet, and extends beyond Pittston; the latter city being the objective point for the present.

Four of the obstructions before mentioned, namely:

	Feet.
Gas House Riff, having a fall of	2.23
Riff at foot of Monockonock Island	3.10
Riff at head of Monockonock Island	1.55
Riff and shoal at Wintermoot Island	2.33
Have a total fall of	9.21

Recapitulation and estimated cost of works, exclusive of those under contract.

Locality.	Rock.	Dredging.	Diking.
	Yards.	*Yards.*	*Feet.*
Gas-House Riff		2,700	300
Hillman's Riff	500		
Forty Fort and Culver's Island Shoal		11,000	
Ram's Horn, or Riff, at foot of Monockonock Island		5,300	150 250
Riff at head of Monockonock Island		5,500	600
Wintermoot Island Shoal		5,300	
Wintermoot Island Riff, at head	150	2,700	375
Total	650	32,500	1,675

ESTIMATE.

650 cubic yards rock, at $10 per yard	$6,500 00
32,500 cubic yards gravel, at 90 cents per yard	29,250 00
1,675 linear feet diking, including filling, at $5	8,375 00
Cost of work	44,125 00
Add 10 per cent. for contingencies and superintendence	4,412 50
Total cost	48,537 50

BRIDGES AND FERRIES.

At Nanticoke the Susquehanna River is spanned by a covered bridge, and there is neither ferry nor bridge for 6 miles above, until the one belonging to the Delaware and Hudson Coal Company is reached, just above Richard's Island. This is only a railroad bridge, and is a substantial, covered, single-track wooden-truss structure, 850 feet long, resting on five stone piers and abutments, which are of sufficient width to carry a double-track bridge.

The next above is at the city of Wilkes Barre; is a covered wooden bow bridge, 700 feet long, resting on three stone piers and abutments; has a double carriage-drive with footways either side, and is crossed by the Wilkes Barre and Kingston Street Railway.

The floor is 33 feet above low water. No others exist between this and Pittston, 8 miles distant; but in the interval are two rope ferries, one at Forty Fort, the other at Wyoming, operated when floods and ice do not prevent.

Two bridges, only 850 feet apart, connect East and West Pittston; both are comparatively new structures, replacing those carried away by the ice freshet in 1875.

Each one is an open iron superstructure about 1,000 feet long, having a wide roadway and foot-walks on either side; the lower one rests on four substantial stone piers, and the floor is 40.5 feet above low-water; the other has only three piers, is built on an incline to cross the Lehigh Valley Railroad above grade, and the floor at the northwest end is 40.5 feet above low-water, while the other end is 54 feet above.

The drainage area of the North Branch, above Wilkes Barre, is 7,000 square miles. The average rainfall about 40 inches. The rapid rise during heavy and extended rains, followed by equally rapid subsidence, is indicative of the lack of low lands and swamps and the steep gradients of the topography of the country drained.

NAVIGATION.

In 1771 the assembly of the province of Pennsylvania declared the Susquehanna River a public highway, and the residents along the river proposed to pay a percentage of the cost of making the stream navigable in order to gain better facilities for marketing their productions. The province having made an appropriation for the purpose, lodged driftwood, stumps, and trees were taken out, gravel bars removed, a general channel opened, and towing paths built around the rapids. This at first extended from Wrightsville to Wyoming, and subsequently was continued to the New York State line; no records giving draught of water obtained, &c., have been found, and it is highly improbable that much material was removed.

The "Durham" were the first boats used and were about 60 feet long, 8 feet beam, and 2 feet deep, drawing when loaded about 20 inches; they were sharp at both ends, and though mounted with two sails, setting poles were the only reliable means for propulsion.

In 1825 were built three steamboats for use on the Susquehanna River; one of them on trial, when loaded, made 4 miles per hour against the current, but four months were occupied in going from York Haven to Binghamton, N. Y., and return, causing pecuniary loss and consequent retirement of the boat.

Another proceeded with great difficulty upward until Nescopeck Falls were reached, attempting to pass up which, losing her headway, the current swung her around on the rocks and her boiler exploded.

The third boat made the experiment on the West Branch unsuccessfully. This ended the steam navigation scheme for some time.

In 1828 the North Branch Canal was begun under an appropriation from the State and finished to the Lackawanna River in 1834.

Another experiment was now made by parties interested in the coal business. Wishing to reach New York State with their fuel, to navigate the river with a steamboat a strong, 40 horse-power boat was built, making the trial trips from Owego to Wilkes Barre, 100 miles, in eight hours, and after making one successful trip was sunk in the Nanticoke Dam.

Another steamer was put on the river in 1849, and during three years, when there was sufficient water in the stream to allow navigation, transported coal to various points; the business not being remunerative was then abandoned.

Still another attempt was made in 1851, when, it is recorded, the first paying business in freighting was done, lasting only during the spring months while the rains kept the water to a good stage; these having ceased, the boat was left high on shore, soon becoming unfit for service.

This ended all attempts to navigate this river for freighting purposes and over long distances. Since this time, however, a moderately paying business has been established by a few small passenger boats plying between local points, which are mostly connected by deep water.

FLOODS.

The Susquehanna Valley, in common with others on the eastern slope of the Blue and Alleghany ranges, all of which have considerable descent to tide-water, has suffered from freshets and floods, especially since the timber is being cleared off the slopes, allowing unimpeded and rapid delivery of heavy rainfalls into the streams leading into the main stream passing through it. Floods have occurred in the Wyoming Valley at various times, when the waters were from 25 to 30 feet above low-water, entirely submerging the country from mountain to mountain, and causing great destruction to life and property.

Works of an engineering nature must be well and strongly constructed to withstand such floods, but are liable to be rendered inoperative by the deposits of quantities of gravel and broken stone moved by the rush of waters and left by decreased velocities at natural points, and also by the opening of new channels, unless artificially provided for.

FISHING AND DAMS.

Fish generally, but notably shad, were very abundant in early years in the Susquehanna River. The construction of the canals and river dams, affording means of transportation, has deprived the territory above Columbia of this article of food except by shipments; the dam at Columbia was erected to allow such migratory fish to reach the upper waters, but appears to have been a failure.

I have seen it estimated that if the carrying traffic now done by the canals was transferred to the railroads, and the dams destroyed, the supply of fish resulting along the river would add more to the wealth and comfort of the people than is now produced by the canals, and that the catch annually would amount to $1,000,000 between the mouth of the Chesapeake and New York line.

It is probable that from the latter points to a long distance below this valley no fish in any quantity would be taken, as it is known they do not prosper where mine or acid water exists, and the action of this water, before becoming neutralized, must extend far below the mining regions.

RAILROADS.

There is now to be found in the Wyoming coal field numerous railroads with connections reaching to nearly every point that could be touched by water communication. They are operated throughout the entire year, while water communication in this latitude is virtually closed nearly one-half that time.

COAL AND OTHER MINERALS.

Coal outcrops in the Wyoming Valley were found in several places: Nanticoke Creek had cut and exposed a 7-foot vein; Ransom's Creek, at Plymouth, had laid bare a 9-foot vein; the Susquehanna River had exposed the coal at Pittston; while the Lackawanna had cut through veins at a number of places. By some it is supposed that the Indians hereabouts knew of the combustibility of stone-coal.

The first successful burning of coal for domestic purposes, or in a grate, was in 1811, in Wilkes Barre. "Stone coal" is noted on a draught made from surveys on the west side of the Susquehanna River in 1768.

In 1766 two boat-loads of coal were mined near Mill Creek, about 20 tons of which was hauled from Harrisburg to Carlisle. This delivery was continued annually during the Revolution. The coal must have been used exclusively in forges for blacksmithing.

To illustrate the difficulties experienced in the introduction of this fuel, rarely could purchasers be found, and usually when trial was made it was given up in disgust. One small shipment, proving unsalable, was taken by the authorities of Philadelphia as a matter of experiment, and when they attempted to burn it under the boilers at the water-works it put the fire out; the remainder was broken and scattered in place of gravel on the sidewalks.

After the discovery of the grate proved that coal could be used for heating purposes, small quantities were mined and shipped by boats and wagons to various localities, but it took a number of years for its real introduction. The coal era in this region is generally considered to have begun in 1820.

The completion of the canal to Nanticoke in 1830 gave a great impetus to the coal business, and was greatly augmented by the construction of the tide-water "canal," from Columbia to tide-water.

Thirteen years after this, the discovery that anthracite was valuable for generating steam and smelting iron caused a rapid increased demand.

In 1866 the North Branch Canal was finished, connecting the coal fields with New York State.

The total amount mined up to 1860 in this valley amounted to 23,000,000 tons, equal to about two years' production now.

According to the State geologist, Professor Rogers, and others, this northern coal field extends in length 50 miles, and contains 187 square miles. The veins of coal range from two to ten in number, and are from 1 to 24 feet in thickness, aggregating at Wilkes Barre a total of 83 feet of coal, and an average for the basin of 45 feet. The entire depth of the coal-measure is 1,200 feet, the field bearing a semblance to a canoe, the synclinal axis dipping under the river.

The total anthracite region in Pennsylvania, and this comprises nearly all of this variety in the United States, is 469 square miles, nearly one-half of which lies in the valleys of the North Branch of the Susquehanna and its principal tributary the Lackawanna River.

The total coal out-put for 1879 was 26,000,000 tons, of which 12,500,000 came from these valleys.

The quantity here in bed is estimated at 9,000,000,000 of tons, and, deducting waste of two-thirds, the yield of merchantable coal will be about 3,000,000,000 tons.

Practical men calculate on mining 1,000 tons to the foot per acre, allowing for pillars and waste.

According to the statements of some parties, $15,000,000 worth of fuel are lost annually in getting out and preparing the coal for market.

There are now on fire five coal mines in Pennsylvania, one of which, near Pittston, has been burning three years; some of the others as long as twenty years.

No other minerals of consequence are found in this region, excepting iron ore in a few localities in small veins and of average richness.

I am, colonel, very respectfully, your obedient servant,

JOHN H. DAGER,
Assistant Engineer.

Col. WILLIAM LUDLOW,
Corps of Engineers, U. S. A.

LETTERS OF MR. STEUBEN JENKYNS.

WYOMING, *August* 26, 1880.

It has always seemed to be a great pity that the Susquehanna River was not, like the Connecticut, the Hudson, the James, the Mississippi, and other rivers of the country, navigable for steamers and sailing vessels. The vast deposits of iron ore and coal, the immense forests of lumber, and the large agricultural productions along its course would naturally demand a navigable stream to convey them to market and bring back such articles, the product of other localities, as would be needed to develop and market these unbounded and invaluable resources. The early settlers along the river made large use of the stream for the purpose indicated, but it was soon found to be too uncertain and hazardous to place reliance upon. It was, however, their only resource for many years, and the lumber of the Upper Susquehanna was floated down in the spring, June, and fall freshets to the markets below, while the other productions of the region, destined for those markets, were carried in arks of about 40 tons burden, or in Durham boats, of 15 to 20 tons' capacity, while the latter alone were used to bring back goods and other products from the markets below.

In time so strong was the necessity felt for a more complete and reliable system of carrying tonnage in both directions that steamboats, then just showing their capabilities in navigation, were suggested as the means of navigating the Susquehanna, unlocking its vast resources and conveying them to market. In the summer of 1825, three steamboats were built for the express purpose of experimenting on the Susquehanna, and, if possible, to show the practicability of its navigation by steam-vessels. The *Codorus*, built at York, or York Haven, by Messrs. Davis, Gordon & Company, was the first to stem the rapid tide of the Susquehanna. She was constructed mostly of sheet-iron, was 60 feet long and 9 beam, and when laden with her machinery and 50 passengers drew only 8 inches of water. Her engine was ten-horse power and, with a stern wheel, she moved at the rate of 4 miles an hour against the current. In the spring of 1826, Captain Elger commenced with this steamboat his voyage from York Haven up the Susquehanna.

Proceeding on his way he was cheered at every point by crowds of people who rushed to the shores to see the strange monster that traveled up stream without poles, oars, or sails. I recollect seeing her arrive and land at a point opposite the Wyoming battle ground, about the middle of April, to replenish the supply of fuel, and I assisted in gathering and carrying on board some pine knots. Proceeding on up the river the boat in a few days reached Binghamton, from which place she commenced her return trip, and arrived in York Haven after a voyage of four months. The people along the river witnessing the experiment taking counsel of their wishes, believed the experiment a success, and prophesied that the Susquehanna was destined to become in the future a great thoroughfare for steamboats; but the captain who had experienced all the difficulties of the voyage decided against any further efforts to navigate the river by steam, as he believed it to be impracticable to do so profitably or with any certain success.

Further attempts were made by persons sanguine of making steamboat navigation on the Susquehanna a success, but they all resulted in failures and in loss to their projectors, in part from the difficulties of navigation and in part from the fact that there was no arrangement or organization of business to give them profitable employment.

With the failure of steamboat navigation came the demand for a canal along the Susquehanna. The lower division of this canal was commenced in 1826, and was continued and extended on up until in, 1834, it was completed and in navigable order to the Lackawanna. This canal did a large business and was increasing yearly in tonnage until railroads became the favorite means of carrying freight and passengers, and when they were built alongside of the canal, the latter became quite as valueless and as much of a failure as steamboating was thought to be.

But with the canal and the railroads all in full operation there still lingers in the minds of many the idea that steamboating on the Susquehanna can yet be made to pay, that the matter has not been fairly tested, and that if the channel at difficult points shall be properly cleared and condensed there will be no difficulty in passing the worst of these points with a boat of light draught at any and all seasons of the year.

We have had in operation for some years past a line of steamboats between Wilkes Barre and Nanticoke, which have been able to make the passage at all stages of the water, notwithstanding the fact that one of the most rapid, shallow, and difficult places in the river have to be passed in the route, and no artificial means to improve the channel have been made use of.

Hon. Hendrick B. Wright, who projected this line of steamers, and who contributed largely of his means to put it in operation, and for whom the largest of the boats is named, is strongly of the opinion, from the results developed by the present line, that not only can the Susquehanna be made navigable for steamers from Nanticoke to Athens, but that it can be made profitable as a business as well as to the people along the river.

With this idea strongly impressed upon his mind, he sought and obtained from Congress an appropriation of $15,000 to clear and condense the channel of the river from Nanticoke to Pittston, with the view of further testing the capabilities of the river between those points for steamboat navigation. If this can be successfully accomplished, there would seem to be no doubt or difficulty about extending the work to Athens, as some of the most difficult places in the river are found between Nanticoke and Pittston. The plan that would result in making those places navigable would succeed at every other point. It is undoubtedly true that steam navigation on the Upper Susquehanna has not had a full and fair trial, and can only have it by clearing the stream from obstructions and condensing the waters at a low stage into a narrow compass, thereby making a navigable channel out of a flow of water which cannot now be said to have a channel. We, here in Wyoming Valley, are all deeply interested in the experiment, and shall look on the work with interest, hoping for its success.

If the stream can be made navigable, there is no doubt of the financial success of steamboating to a limited extent. From Nanticoke to Pittston, a distance of 18 miles, we have a population of over 50,000, distributed and so connected in business interests and operations that there is a large and constant intercourse between the various points, to wit: Nanticoke, 5,000; Plymouth, 10,000; Wilkes Barre, 25,000; Forty Fort, 1,000; Fort Blanchard, 1,000; Wyoming, 1,200; Pittston, East and West; 10,000, besides the country round about.

Such a population, so connected, necessarily furnishes a large amount of travel besides a large amount of freight. Beside the necessary travel should be reckoned the immense number of excursions now so common and popular, and every day becoming more so. And no place in the world furnishes a more delightful and interesting ride for an excursion than the Susquehanna from Pittston to Nanticoke. The many beautiful towns, the beautiful windings of the stream, its green and woody banks, and the delightful views of mountains and low-lands, varied at every turn, make the scene one of constant delight. Add to this the cool and refreshing breezes that come from the water, and the pleasure is increased a hundred fold.

But in addition there is a charm in the historical associations of the localities by which they pass that adds an interest to every point. There is Shawnee, where Zinzendorf came to preach to the Indians, and had such an interesting experience; and there is Forty Fort, from which the little band of patriots went out to battle and to death; and there is Monockonock Island, to which many of the fugitives fled only to be hunted down and slaughtered; there is the monument that marks the place where the slain were buried; and there is the battle-field where they met an overwhelming force of the invaders of their homes, and before whom they fell as wheat before the reaper; and there, too, is Jenkins Fort and Pittston Fort—all interesting localities, and all to be seen from the deck of a steamer in a ride from Nanticoke to Pittston. In fact, every foot of the ground is historic and calls up the most hallowed memories. The interest in these localities and their associations is growing deeper and more intense with each departing year, and will add largely to the travel not only from the citizens of our lovely valley but from strangers who shall visit on pleasure or on business.

Let us, then, by all means encourage the attempt to make the Susquehanna navigable for steamers, and its success will be both delightful and profitable to all.

A great deal more might be said upon this interesting and important subject, but this must suffice for the present.

STEUBEN JENKYNS.

F 19.

CONSTRUCTION OF PIER IN DELAWARE BAY, NEAR LEWES, DELAWARE

The appropriation of $10,000 for continuing work on the Lewes Pier made in act of June, 1880, was as proposed in annual report, 1879–'80, expended in replacing in part portions of the timber superstructure that had become defective from decay, and in putting in position the fender piles for the pier-head.

The piles were of yellow pine, the greater number of them 60 feet in length, 8 to 9 inches diameter at the small end, and 15 inches or more at the butts, creosoted with 12 pounds of oil to the cubic foot.

In practice, owing to formula used by the contractor, the saturation of the timber was found to average about 10 pounds to the cubic foot concentrated in the outer shell of wood which equaled half the whole contents of the stick. The inner cylinder, equaling the remaining half, was nearly free from oil except near the ends. Practically, therefore, the outer half of the pile was saturated to the extent of 18 or 19 pounds to the cubic foot, which insures the protection of the pile against decay and the worm so long as the saturated shell shall remain.

The accompanying report gives the result of tests by Captain Ludlow of the preserving quality of the creosoting process.

As the creosoted piles could not be delivered before October, active operations began October 1 in constructing a pile-driver and repairing other plant, including a new set of flues in the boiler.

As the piles were to be driven 4½ feet outside the pier, the driver projected 5 feet, the rear and platform being loaded with the engine and tank. A hammer weighing 1,810 pounds was obtained from the neighboring railroad company.

The first cargo of piles, 84 in number, was delivered on October 14.

The piles first driven near the shoulder of the pier-head penetrated hard bottom, mainly fine sand, and reached a depth of 13 to 18 feet only.

The transition from hard to soft bottom was made suddenly at the twelfth pile. Number 11 required 75 blows of the 1,810-pound hammer to drive it 14 feet, into the bottom, while No. 12 was sent to the gravel stratum, 23 feet into the bottom, with 21 blows, the two piles standing 7 feet apart only. This is a remarkable change in the nature of a sea bottom within so short a distance. It was in this vicinity that two years ago it was found necessary to raise, lengthen, and re-drive the iron piles of the 57th row.

The season's work was ended December 20, the last cargo of piles, bolts, and washers having been delivered November 15.

The yellow-pine lumber, comprising material for the superstructure, to the amount of 24,000 feet, was delivered in May, 1881.

Pile-driving was resumed on June 13, and continued to the end of the fiscal year.

On June 9 bids were opened, and subsequently a contract was awarded for the delivery of 63,603 feet of yellow pine needed to replace defective timber in the pier-head.

This matter of the decay of timber already in position is assuming rather formidable proportions. It was referred to in the Annual Report for 1879–'80 in the following terms:

> This increase (of $6,500 in the estimate for completion) is directly traceable to the insufficiency of the annual appropriations, involving an increased maintenance and contingent account, which could not be originally provided for, and which has made

the carrying out of the original estimate an impracticability. During the eight years that the pier has been constructing the timber has suffered from natural decay and deterioration, until now, after a careful examination by the resident assistant engineer, he estimates that not less than 15 per cent. of that in the pierhead and 40 per cent. of that in the bridge part will need to be replaced before the pier can be considered ready for use. The amount now asked for completion during 1882 will suffice for that purpose if appropriated as a whole.

The amount referred to as necessary for completion was $21,000, and the amount appropriated March 3, 1881, was $10,000 only, thereby deferring for at least a year more the completion of the work, and necessitating a further increase in the cost of not less than $2,000.

During the ensuing fiscal year the $10,000 appropriated March 3, 1881, will be expended in driving the remaining fender piles and connecting them with the pier, and in replacing the floor joists of the pier head, half of which are rotten, with sound material of greater cross section.

During the fiscal year ending June 30, 1883, should suitable appropriation be made, the pier will be completed by finishing the superstructure, replacing rotten timber, laying the railroad stringers and track on the pier and thence to the limits of the United States Pier Reservation, and placing mooring buoys in position for the common protection of both vessels and pier.

The amount required is $13,000.

Meanwhile, the use of the pier as a "landing pier" for shipping, an appellation specially designated in the act making the original appropriation, is, even in its incomplete condition, considerably increasing. The vessels of the Light-House Establishment have used it for two years past to land stores for the several lights in the vicinity, and it is constantly resorted to in heavy weather from shipping in the harbor, when a landing at any other point would be impossible.

On April 5, 1881, during a hard gale from the north-northwest, a heavy schooner, after losing both anchors, boldly sailed for and made fast to the pier, and lying against the fender piles rode out the gale in safety. The railroad company, so soon as the completion of the pier shall have been provided for, will no doubt extend its track thereto, and using it for the steamer traffic to and from New York, will make its own repairs.

The appended statistics are a statement of the amount of freight received and shipped by this company, which is an increase since 1879 of nearly 6,000 tons.

AMOUNT OF FREIGHT HANDLED AT THE RAILROAD PIER, DELAWARE BREAKWATER HARBOR, BETWEEN MAY 1, 1880, AND MAY 1, 1881.

	Pounds.
Forwarded	59,859,920
Received	7,751,791
Total	67,611,711

or 30,184 long tons, an increase of 5,947 tons since 1879.

This work is in the collection district of Delaware, the nearest port of entry being Wilmington, Del.

Fort Delaware is the nearest fort, and the Breakwater light is the nearest light-house.

Total appropriations to June 30, 1881	$355,500 00
Total expenditures to June 30, 1881	346,078 30

Money statement.

July 1, 1880, amount available	$10,005 54	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$20,005 54

July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$10,583 84	
July 1, 1881, outstanding liabilities	494 54	
		$11,078 38
July 1, 1881, amount available		8,927 16
Amount (estimated) required for completion of existing project		13,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		13,000 00

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, at 12 *o'clock m., August* 17, 1880 *for furnishing materials for the United States pier near Lewes, Del.*

No.	Names of bidders.	Residence.	Yellow-pine lumber per M feet.	Piles 50 feet long. Delivered at Lewes, Del.	Piles 50 feet long. Delivered at Brooklyn, N. Y.	Piles 60 feet long. Delivered at Lewes, Del.	Piles 60 feet long. Delivered at Brooklyn, N. Y.
1	Isaac A. Peck	Redden, Del	....	$6 75	....	$6 75	
2	John M. Houston	Millsborough, Del	....	4 75	....	5 70	
3	Eppinger & Russell	New York City	$35 00	....	$18.90	....	$19 50
4	J. W. Gaskill & Sons	Philadelphia, Pa	39 00	15 00	....	17 00	
5	John E. Davis	Frankford, Pa	....	6 00	....	6 00	
6	Paul I. Field	Philadelphia, Pa	....	....	....	....	
7	I. W. Hoffman & Co	Philadelphia, Pa	....	....	....	....	

No.	Names of bidders.	Wrought iron bolts, 1¼ by 33¾ inches.	Wrought iron bolts, 1⅛ by 26¼ inches.	Wrought iron washers.	Cast iron countersunk washers.	Cast iron flat washers.	Remarks.
1	Isaac A. Peck	....	....	....	....	....	
2	John M. Houston	....	....	....	....	....	
3	Eppinger & Russell	....	....	....	....	....	Piles creosoted.
4	J. W. Gaskill & Sons	....	....	....	....	....	
5	John E. Davis	....	....	....	....	....	Informal bid.
6	Paul I. Field	$0 07½	$0 07.4	$0 07½	$ 04½	$0 04.4	
7	I. W. Hoffman & Co.	04	04	04	03	03	Informal bid.

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, Philadelphia, Pa., at 12 *o'clock m., June* 9, 1881, *for furnishing yellow-pine timber for United States piers near Lewes, Del.*

No.	Bidders.	Residence.	Price per M feet.	To deliver.
1	Eppinger & Russell	New York	$31 00	Within 90 days of date of contract.

Abstract of contract entered into by Col. J. N. Macomb, Corps of Engineers, during the fiscal year ending June 30, 1881, *for construction of pier in Delaware Bay near Lewes, Del.*

Name of contractor.	Residence.	Yellow-pine lumber.	Piles, creosoted, 50 feet long.	Piles, creosoted, 60 feet long.	Date of contract.	Remarks.
Eppinger & Russell.	New York City.	*Per M ft.* $35 00	*Per M ft.* $18 90	*Per M ft.* $19 50	1880. September, 14.	Completed June 6, 1881.

REPORT OF CAPTAIN WILLIAM LUDLOW, CORPS OF ENGINEERS, RELATIVE TO USE OF CREOSOTE FOR PROTECTING SUBMERGED TIMBER.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., March 15, 1881.

COLONEL: I have the honor to submit the following report of tests made in the Delaware Breakwater Harbor to ascertain the effect of modern creosoting processes in protecting timber submerged in sea-water in that locality from the attack of the teredo.

The tests had especial reference to the proposed application of pine fender piles to the government pier now under construction in the harbor, and are thought to possess some general value in view of the probable extensive use of timber in marine works should the process prove effectual.

Under average conditions a pile or other piece of wood exposed to the teredo in Delaware Bay near the capes is practically destroyed in about three seasons (the period varying 50 per cent. with the nature of the wood itself, the circumstances of its exposure and the existing meteorological conditions), that is to say, while presenting a fair appearance externally it will have been so perforated by the worm as to forbid any dependence upon its strength, and a slight blow or pressure will break or crush it.

For the purpose of the test I procured from Mr. Edw. R. Andrews, the proprietor of the "Hayford" process, four similar blocks of yellow pine, two creosoted in accordance with his process, and two in their natural condition.

The description of these blocks is given in the following—

TABLE I.

No.	Condition.	Dimensions.	Weight as received.
			Pounds.
1	Natural	5 by 5 by 22½ inches	15¼
2	Creosoted	5 by 5 by 22¾ inches	21
3	Natural	5 by 5 by 22½ inches	14¾
4	Creosoted	5 by 5 by 22¾ inches	22

From this table is deduced—

TABLE II.

Blocks.	Contents.	Average weight.	Difference in weight.	Weight per cubic foot.	Specific gravity.	Percentage of increase.
	Cub. ft.	*Lbs.*	*Lbs.*	*Lbs.*		
Natural	0.326	15		46	0.73	
Creosoted	0.329	21½	+6½	65.28	1.04	43

The weights given in these tables are not exact by reason of the want of delicacy of the weighing apparatus. The comparisons are probably accurate. The creosoted blocks weighed on the average 6¼ pounds more than the natural ones, and exceeded them in length by ¼ inch. As stated by Mr. Andrews, the saturation of the blocks was to the extent of 12 or 15 pounds to the cubic foot. The comparison of weights, however, proves that the actual saturation must have been as high as 19 or 20 pounds. It might not be safe to infer that the additional length was due to the treatment, although it was intended they should all be the same original dimensions. The specific gravity of the natural blocks is considerably higher than is given in most of the ordinary tables, of reference for yellow pine, and agrees with that given by Trautwine. The blocks were bolted together in pairs, and placed in the water August 9, 1878, near the end of the iron pier, 1,700 feet from shore. The couple, consisting of Nos. 1 and 2, was submerged to a depth of 19 feet below low-water, and 3 or 4 feet above the bottom. Nos. 3 and 4 were placed about 3 feet below low-water. The plane of maximum exposure to the teredo is near low-water, but the couples were sunk deeper to provide against accidental loss.

After remaining in the water twenty-two days the blocks were taken up on August 31, separated, and weighed, to ascertain the amount of water absorbed by each, with the following result:

TABLE III.

No.	Weight dry.	Weight wet.	Gain.	Absorption.
1	15½ pounds	19 pounds	3½ pounds	22.6 per cent.
2	21 pounds	22 pounds	1 pound	4.8 per cent.
3	14½ pounds	17½ pounds	3 pounds	20.7 per cent.
4	22 pounds	22½ pounds	½ pound	2.3 per cent.

The variation in the results is partly due to the scales and partly to the water not having been thoroughly removed from the surface, and to the presence of rust from the connecting bolts.

Having been reconnected and replaced in the water as before, on the same day, the blocks remained undisturbed until January 6, 1879, when it was feared that the heavy ice rapidly filling the harbor might carry the upper couple away.

Upon examination several small holes where the teredo had entered were observed in the untreated blocks.

The couples were returned to the water March 18, 1879, and remained until September 16, 1880, when it was observed that the iron rod to which they were attached was nearly rusted through.

After being taken up and allowed to dry the blocks were again weighed.

TABLE IV.

No.	Original weight.	Final weight.	Loss.	Per cent.
1	15½ pounds	11 pounds	4½ pounds	29 per cent.
2	21 pounds	21 pounds	0 pounds	0 per cent.
3	14½ pounds	10 pounds	4½ pounds	31 per cent.
4	22 pounds	22 pounds	0 pounds	0 per cent.

The total time of submergence was 698 days.

The average loss in weight of the natural blocks is 30 per cent., which is probably less than the true amount, since the interior cavities had not been thoroughly deprived of moisture.

The loss of the block nearer low-water was, as might have been anticipated, the greater of the two. Examinations showed that the natural blocks had been largely destroyed by the teredo, while the creosoted ones were perfectly sound. There were only visible on the ends of these slight punctures where the young worms had unsuccessfully attempted to make a lodgment.

The sound condition and absence of any change in weight in the creosoted blocks after drying showed that the oil had protected the wood from the teredo, and had also resisted any chemical or mechanical tendency of the water to remove it, a point with regard to which doubts have been felt.

The tests of these blocks will be continued.

Very respectfully, your obedient servant,

WILLIAM LUDLOW,
Captain of Engineers,
Bvt. Lieut. Col., U. S. A.

Col. J. N. MACOMB,
Corps of Engineers, U. S. A.

F 20.

DELAWARE BREAKWATER HARBOR.

A condensed account of the original construction and present degree of efficiency and condition of this, the greatest harbor of refuge on the coast, is given in Annual Reports Chief of Engineers, 1879, pages 453–462, and 1880, page 610.

During the past year nothing has been done (beyond the partial removal of the several wrecks which have been lying in the harbor since October, 1877) towards increasing its protective capacity, nor to retard the shoaling which has for many years been in progress.

The use of the harbor and its value to the general commerce of the country are yearly increasing, while the depth and area are as steadily diminishing.

The act of March 3, 1881, directs that a survey be made of the harbor and its approaches. This survey will be made during the ensuing season, and will indicate, by camparison with previous charts, the changes and deterioration that have taken place.

It is not necessary, however, to await the result of this examination in order to begin the work of restoration.

The closure of the "gap" between the breakwater and the ice breaker has been nearly unanimously recommended by officers whose duties have required them to investigate the subject, with the double object of increasing the barrier against northeast gales and of compelling the ebb tides, which now escape through the gap, to traverse the harbor and lend their influence towards checking the formation of the shoal near the Breakwater light.

The general estimate for this is $500,000 or $600,000, and the Board of Engineers in February, 1879 (Annual Report, 1879, pages 456–57) urgently but ineffectually recommended an immediate appropriation of $150,000 for beginning the work.

The probable explanation of the apparent lack of appreciation of the value of this harbor, that has cost the general government nearly $2,250,000 and is now in danger of becoming useless, is that the interests concerned in its preservation and utilization are entirely general, and represented by persons whose number in the aggregate is enormous, but whose individual influence is small and without means of concentration. It is not the great steamship and transportation lines, but the thousands of domestic coasters, sailing deep laden from every port on the Atlantic and Gulf coasts and manned by the hardest-worked and worst-paid men in the country, that need and seek the refuge which it is the duty of the nation to supply.

The past winter was exceptionally severe and the formation of ice in all parts of Delaware Bay and River was unprecedented in amount and duration.

The accompanying report from Mr. Stierle, the resident assistant, gives the main particulars with regard to the Breakwater Harbor. His statements show that the "ice-breaker" so called, furnishes no protection against ice dangers, since the tides traverse the gap freely, moving great masses of ice with them. In fact, the vessels most narrowly escaping disaster were those anchored under the "ice-breaker," which were swept by the ice through the gap and nearly wrecked upon the breakwater.

The "ice-breaker" is, as the works now stand, simply a partial shelter against gales blowing down the bay, and furnishes no protection against either northeast gales through the gap or the movements of ice, which are influenced more by the tides than the winds.

The number of vessels seeking shelter has not been officially reported during the last year. During the year previous the number was 14,000, of which not less than nine-tenths belonged to the domestic coasting trade, for which no shelter other than the Delaware Breakwater Harbor exists between Sandy Hook and the capes of the Chesapeake.

The local commerce of the harbor continues to increase, as will be seen from the statement below, namely:

AMOUNT OF FREIGHT HANDLED AT THE RAILROAD PIER, DELAWARE BREAKWATER HARBOR, BETWEEN MAY 1, 1880, AND MAY 1, 1881

	Pounds.
Forwarded	59,859,920
Received	7,751,791
Total	67,611,711

or 30,184 long tons, an increase of 5,947 tons since 1879.

This work is in the collection district of Delaware, Wilmington being the nearest port of entry. The nearest fort and light-house are, respectively, Fort Delaware and Delaware Breakwater light.

REPORT OF MR. A. STIERLE, ASSISTANT ENGINEER.

UNITED STATES PIER NEAR LEWES, DEL.
March 15, 1881.

SIR: I have the honor to render herewith a report upon the appearance and condition of the ice in the harbor of the Delaware Breakwater and vicinity during the past winter, 1880–1881.

The first ice formed during the night of December 10, and extended for a width of 300 feet along the shore, the piles of the pier remaining covered, up to high-water mark, with a thick coat of ice during low-water the next morning. This ice projected further into and up the harbor the following day, but disappeared during the night of December 12, on the ebb-tide, a strong southwest wind driving it to sea.

New ice began to form rapidly at the beginning of the cold spell that set in shortly after Christmas, and on December 30 the harbor was full of drifting ice, extending to the breakwater and beyond.

The ice inshore of the bar, all along the shore, became packed and did not move until January 4, when it broke loose, a westerly wind setting it off shore.

Notwithstanding the fact that the temperature remained comparatively mild until January 8, great quantities of floating ice fields passed through the harbor on the ebb and flood tide. Subsequently the temperature remained below freezing, and ice commenced to form along shore, packing to such an extent upon the bar the next day that the flow of the tides did not affect it, no movement being perceptible.

Large fields of ice continued to pass through the harbor until January 21, when a heavy rain and westerly gale melted it or drove it off shore, and no ice was visible in the harbor or bay January 22.

January 27, slush-ice was again observed along the shore. The temperature continued to remain below the freezing point from that day until February 5, falling on several days to only a few degrees above zero. During that period the formation of ice assumed proportions seldom observed in this region. Huge cakes of Delaware River ice—easily distinguishable from the salt-water ice—that had floated into the harbor during the previous week, were cemented together by new ice, forming large fields which extended out to the channel of the bay and became so solid finally that, on February 2, a few sailors walked from the breakwater to the shoals near the cape, a feat accomplished subsequently in all directions across the harbor by many persons up to February 8, when the temperature became milder and the ice began to move again with the tide in the vicinity of the point of the cape.

The thickness of the ice-cakes did not probably exceed 15 inches; but as nearly all of them had frozen together in a slanting position, lapping each other more or less, the masses of ice in some places greatly exceeded this thickness during the coldest days.

The break-up, which took place gradually after February 9, was not accompanied with any casualties to the shipping or works in the harbor, a fact mainly due to the prevailing calm weather and light southerly winds.

Two ships, one bark, and a light-vessel, having anchored near and outside the breakwater and ice-breaker when the severe freezing commenced, broke their moorings on the first pressure of the ice, and were carried near, and two of them partly upon, the stone-works, where they remained several days until towed away. A brig and two schooners anchored inside the harbor dragged their anchors under the same circumstances, and got into dangerous proximity to the point of the cape, whence they drifted away unhurt at the breaking up of the ice. About forty vessels were fast in the ice at this time, none of them sustaining any material damage.

A better idea of the solidity of the ice during these days may be formed from the fact that city ice-boat No. 3, on February 4, p. m., consumed four hours in breaking her way towards the "gap" from the railroad pier, where she had arrived the previous night.

Two days later city ice boat No. 2 spent nearly as much time in making half that distance to get near No. 3, then lying in the middle of the harbor, to replenish the coal bunkers. The Old Dominion steamer Breakwater, unable to make harbor and to break through the ice when near the capes, on Friday, February 4, was compelled to return to New York.

After the ice had begun to move all over the bay during the night of February 9, the warmer temperature made it disappear rapidly, and the harbor was free of ice again February 14, since which date, on two or three occasions, slush-ice in small quantities has been observed along the shore after a particularly cold night, the last time on the 2d of this month.

The past winter has forcibly demonstrated the inadequate protection afforded by the present works, and has apparently awakened a more than passing interest in the much-needed improvement of this harbor.

Very respectfully, your obedient servant,

A. STIERLE,
Assistant Engineer.

Capt. W. LUDLOW,
Corps of Engineers, Bvt. Lt. Col., U. S. A.

F 21.

REMOVAL OF WRECKS FROM DELAWARE BREAKWATER HARBOR.

Under a special act, approved January 23, 1880, appropriating $25,000 for the removal of these wrecks, originally 10 in number, which had been lying in the harbor since October, 1877, contract was made April 22, 1880, after due advertisement, for their complete removal by August 1, 1880. Although it included the most favorable months of the year for such work, the time stipulated in the contract expired before a single wreck had been removed, and as the contractor was unwilling to alter his method of operating or to increase his working plant, which consisted of 1 small schooner and a diving apparatus, and refused to guarantee the removal of more than 3 wrecks, even should the time be extended to December 1, his contract was annulled; new advertisements were issued and a new contract made August 31, 1880.

The loss of the best portion of the season of 1880, the early advent of winter, and the late and boisterous spring greatly retarded the work, but by July 1, 1881, 3 wrecks had been completely removed, and two others were nearly ready, leaving 3 more in the Breakwater Harbor and the "Addie Walton" in the main ship channel near Cross Ledge light to work upon. As the contractors had an improved and adequate plant in operation and would evidently clear the harbor if allowed to continue, an extension of time to October 1, 1881, was granted them.

The wrecks lie in 15 to 20 feet of water, and by subsidence and formation of shoals are nearly imbedded in mud. The wrecking plant consists of a steam propeller of 250 tons, carrying all necessary apparatus, with quarters for the crew of 17 men.

The vessel is moved over the wreck and a centrifugal pump of improved pattern discharges the coal, and frees the wreck from mud.

Chains are then passed through the keelsons and attached to wood pontons. The use of the pump to wash away the external mud, and even several light blasts are required before the hull yields to the lift of the pontons and leaves its bed. The wreck is then towed to sea outside the capes, and let go in 16 to 20 fathoms, beyond possibility of future injury to shipping.

The work will no doubt be completed before October.

Total amount appropriated (by act of January 21, 1880) to June 30, 1881..	$25,000 00
Total amount expended to June 30, 1881	2,763 98

Money statement.

July 1, 1880, amount available		$23,773 22
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	$1,806 20	
July 1, 1881, outstanding liabilities	17,446 50	
		19,252 70
July 1, 1881, amount available		4,520 52
Amount that can be profitably expended in fiscal year ending June 30, 1883.		5,000 00

Abstract of proposals received by Col. J. N. Macomb, Corps of Engineers, at 12 *o'clock m., August* 17, 1880, *for removal of wrecks from Delaware Bay and Delaware Breakwater Harbor.*

No.	Names of bidders.	Residence.	Names of wrecks. Addie Walton.	E. B. Wheaton.	W. G. Dearborn.	Babel H. Irons.
1	George Dick	Baltimore, Md	$2,468 75	$2,468 75	$2,468 75	$2,468 75
2	McDonald & Cuming	Astoria, N. Y	2,156 25	2,156 25	2,156 25	2,156 25

No.	Names of bidders.	Names of wrecks. Jessie Wilson.	W. A. McGahan.	Mary E. Smith.	J. B. Austin.	Total amount of bid.	Remarks.
1	George Dick	$2,468 75	$2,468 75	$2,468 75	$2,468 75	$19,750	
2	McDonald & Cuming	2,156 25	2,156 25	2,156 25	2,156 25	17,250	Lowest bidder.

Abstract of contract entered into by Col. J. N. Macomb, Corps of Engineers, during the fiscal year ending June 30, 1881, *for removal of wrecks in Delaware Bay and Delaware Breakwater Harbor.*

Name of contractor.	Residence.	Removal of the wrecks, price of.	Date of contract.
McDonald & Cuming	New York City	$17,250	August 31, 1881.

F 22.

PORT WARDEN'S LINE, PHILADELPHIA, PENNSYLVANIA.

The Advisory Commission of United States officers, consisting of Col. J. N. Macomb, Corps of Engineers, United States Army, chairman; Captain Breese, United States Navy (taking the place of Captain Chandler, United States Navy, ordered to the command of his ship); and Professor Mitchell, United States Coast and Geodetic Survey, with Capt. William Ludlow, Corps of Engineers, United States Army, as secretary, has during the past year had under consideration the subject of the proper determination of Port Warden's lines for both the Delaware and Schuylkill rivers.

The chart of the Delaware, from Bridesburg to below League Island, made for the city of Philadelphia by the Coast Survey, and a chart of the Schuylkill River from recent surveys made under the direction of the United States Engineer Office, Philadelphia, were at the service of the Commission.

An investigation by Professor Mitchell, based upon computations from the Delaware charts by Mr. Marinden, United States Coast and Geodetic Survey, was presented to the Commission and the subject of the Delaware line discussed. The Commission reached the conclusion that an equal supervision of the line on both sides of the Delaware was essential to the attainment of useful results.

Pending correspondence with the New Jersey authorities looking towards an understanding on this subject, further consideration of the Delaware line was suspended and those of the Schuylkill taken up.

On April 2, 1881, a report was presented to the Philadelphia harbor commissioners (a copy of which is herewith forwarded), together with a tracing of the chart of the Schuylkill River from Callowhill street bridge to the Delaware.

Upon this tracing two lines were drawn for each bank for "lines of solid filling" and "wharf lines."

No decisive action had been notified to the Advisory Commission at the end of the fiscal year, but it is hoped a determination will be reached before spring.

REPORT OF THE ADVISORY COMMISSION.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., April 2, 1881.

SIR: The Commission advisory to your honorable Board, recognizing the importance to the interests of this port of a proper regulation of the bank and wharf structures of the Schuylkill River, and additionally urged thereto by the pressure of valuable improvements awaiting the determination of shore-lines for their development, have recently had under careful consideration the conditions and requirements of the tidal section of that stream.

The changes in the composition of the Commission since their organization have been the substitution of Captain Breese, of the Navy, for Captain Chandler, ordered to the command of his ship, and the assignment of Colonel Ludlow, United States Engineers, as secretary.

During their recent sessions, the Commission were deprived of the co-operation of one of their number, Professor Mitchell, of the Coast Survey, whose duties as a member of the Mississippi River Commission have detained him in Saint Louis beyond the time for which it seemed desirable to postpone the consideration of the important matters awaiting decision.

Fortunately, the problems presented for solution offered no special difficulties, unless legal points should interfere, and in the course of the discussion an entire unanimity of opinion on the part of the remaining members was attained.

The recommendations made are, therefore, those of the Commission.

They are based upon the following considerations, involving the physical aspects of the Schuylkill:

1st. While the flow from above the dam at Fairmount augments, in a varying proportion, the total volume, usefully diminishing the velocity of the flood current and increasing that of the ebb, the tidal characteristics of the section between the dam and the Delaware must be regarded as predominant, and the regulation of the stream should conform thereto.

2d. Since any given portion of the river occupies the relation of tidal reservoir to all portions below it, the limiting lines at high-water should be so adjusted as to preserve as much as possible the tidal capacity; that is to say, the area to be filled and emptied by each tide, while furnishing boundaries that shall insure an easy and uniform flow, and gradually widen downward to allow for greater volume passing successively lower sections.

3d. Although the straightening of the stream at certain points is both desirable and practicable to a certain extent, and would considerably increase the ease of navigation, nevertheless caution is required in the application of this means of improvement. Any considerable straightening causes a corresponding decrease in tidal capacity, and a careful consideration of the topography shows that any radical or extensive alteration of the present bed would injuriously affect valuable interests, whose losses would probably overbalance the contemplated benefits. Furthermore, questions of individual rights and of damages to owners would be raised and effect an indefinite postponement of a much-needed adjustment.

4th. For the better accommodation of shipping, a limiting wharf line may be drawn where the topography admits of it, preserving an ample width of fairway. In order not to decrease the tidal area, any structures erected beyond the dike or bulkhead line, should be as open as possible, and built upon piles to 1 foot above the plane of high water.

There are transmitted herewith two tracings from the United States Engineer chart of the Schuylkill, drawn on a scale of 200 feet to the inch, and illustrating graphically the opinion of the Commission as to how the regulation of the river should be effected.

Lines have been drawn on both banks for lines of solid filling and for wharf lines; the former in dark blue, the latter in red.

The bulkhead lines of solid filling are continuous on both banks.

Those for wharf structures are interrupted to correspond to the requirements of each locality, and emerge at times into the bulkhead line.

It is to be understood that both these are "limiting" lines, only. That is to say, when solid structures shall be built, they should stop at the blue lines; wharf structures built beyond the blue lines, should be open ones, terminating on or short of the red lines.

The chart extending only to Callowhill street bridge, the Commission have been unable to continue these lines to the dam, but an examination of their position just below the bridge, will indicate the belief of the Commission that no extension of the present structures into the stream should be made in the upper part of the river.

It will be observed that the blue lines at some points intersect structures already built. This is intended to express the judgment of the Commission that such structures unduly restrict the navigation and are injurious to the stream, and that, consequently, the portions extending beyond the blue line should be removed. In other places, the wharf lines are held back within the line of low water. The reasons therefor are evident from an inspection of the tracings.

Without discussion of the legal rights of riparian owners, in relation to the construction of wharves in tidal waters, the Commission believe that the true interests of all the owners are identical in their dependence for the value of their respective properties upon the maintenance and improvement of the general navigation, and that, consequently, what is for the benefit of all, will command the assent of all.

There are other points in relation to the Schuylkill, to which your honorable body might profitably direct attention, but which do not fall within the scope of the present discussion.

Among these, are the evils to be anticipated in the future resulting from the use of the lower Schuylkill as a receiving basin for sewage and waste products, the unhealthfulness of certain localities bordering on the river from the existence of bodies of stagnant water, emitting malarial and other poisons, and the desirability in the near future of establishing a system of harbor regulations which shall control the mooring and berthing of vessels so as at certain points to keep open a sufficient fairway for the traffic of the stream.

All of which is respectfully submitted.

J. N. Macomb,
Colonel of Engineers,
Chairman Advisory Commission.

Attest:
William Ludlow,
Captain of Engineers, Bvt. Lt. Col. U. S. A.,
Secretary Advisory Commission.

To the Chairman of the Board of Harbor Commissioners
of the Port of Philadelphia.

F 23.

EXAMINATION OF APPOQUINIMINK CREEK, DELAWARE.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., January 1, 1881.

GENERAL: I have the honor to forward herewith report and tracing of chart of Appoquinimink Creek, Delaware, in accordance with section 2 of the river and harbor act of June 14, 1880.

The navigation is shown by the chart to be of good natural capacity, the available depths averaging 7 to 10 feet at low-water. There are reaches, however, where the 6-foot low-water channel is interrupted, aggregating in all about 3,500 feet, the improvement of which would clear the 9½ miles to Odessa.

As a rule, the construction of canals, though of great convenience to shipping, should be projected sparingly from their cost and the partial diminuition of the tidal prism due to the shortening of the stream. At certain points, however, the excessive curvature of the creek is so serious a disadvantage as to justify the construction of cut-offs, such as, for example, at K and H on the chart. When projected they should be so designed as to conform to natural laws. The canal already constructed at I is an illustration of violation of these. The canal at its lower end encounters the creek at right angles, and the flood current tends to pass the mouth, while the ebb strikes the opposite bank. If properly planned, these cut-offs from the greater head, due to shortening the distance, have a brisker flow than that in the stream, and are therefore able to maintain a suitable depth with much less width; but the faulty direction of the cut-off at I diminishes the draught to 4 feet at low-water. A comparatively small addition to the original cost would have given it a suitably-curved direction, with great benefit. If this canal should be widened and deepened, the proper curve should be given it by deflecting the south end eastwardly.

The improvement of the entrance to such depth as can be readily obtained in the creek would require dredging through a distance of 3,500 feet to the 8-foot low-water curve in the bay. The rise of tide and the soft bottom, however, will admit vessels drawing 8 feet or 9 feet, which can then proceed up the improved creek without detention.

Very respectfully, your obedient servant,

J. N. MACOMB,
Colonel of Engineers.

The CHIEF OF ENGINEERS, *U. S. A.*

REPORT OF MR. W. S. EDWARDS, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., December 20, 1880.

COLONEL: The following report and accompanying map of the reconnaissance of the Appoquinimink Creek, Delaware, are respectfully submitted.

The examination extended from Odessa, the head of present navigation, to the entrance, 9½ miles.

* * * * * * * *

The creek is bordered by salt marsh, with occasionally the fast land coming down to the water, and in several places the marsh has been embanked, drained, and cultivated successfully. The country along the creek is a district of rich farming lands, slightly undulating, and generally highly cultivated. The cultivation of fruits and vegetables for the Philadelphia market has been largely entered into. It is a tidal stream, about 20 miles in length, lying altogether in the State of Delaware, and emptying into the Delaware Bay, 5 miles below Port Penn and 46 miles below Philadelphia, having a width of 180 feet at its mouth and 120 feet at Odessa, with an average width of 130 feet. It drains an area of about 59 square miles.

Odessa is a town of about 500 inhabitants, and is 2 miles from Middletown, the nearest railroad communication, and has tri-weekly communication with Philadelphia by steamer. Vessels drawing 7 feet are able to sail up to Odessa at high-water. At present the improvements designed are the deepening of the channel at several points so as to give 6 feet at mean low-water up to the Odessa wharves, and the cutting of canals for the purpose of straightening the creek.

On the accompanying map the different improvements are designated by Roman numerals and letters, and are as follows:

	Length.	Width.	Depth.	Amount.	Cost.	Remarks.
	Yds.	*Yds.*	*Yds.*	*Cub. Yds.*		
I. Rock Beach Shoal	250	13	.55	1,625	$813	Estimated at 50 cents per cubic yard.
II. New Bridge Shoal	146	13	.40	750	375	
III. Pump House Shoal	286	13	.33	1,225	612	
IV. Tom's Bay Shoal	73	13	.66	625	313	
V. Between Tom's Bay and Perch Ditch	632	13	.36	2,675	1,338	
VI. Between Perch Ditch and Peterson's	565	13	.36	2,650	1,325	
VII. Between Peterson's and Phosphate	620	13	.50	4,050	2,025	
VIII. Between Phosphate and Store House	610	13	.70	5,550	2,875	
IX. Odessa Wharf Shoal	166	13	.80	1,725	812	
Total	3,348	....	....	20,875	10,488	
I. Canal to be widened and deepened	450	13	4 to 5	14,000	6,300	45 cents per yard.
B. Canal	817	13	4	17,000	7,650	45 cents per cubic yard.
E. Canal (Drawyen)	250	13	4	14,000	6,300	
F. Canal (Tom's Bay)	670	13	4	36,000	16,200	
H. Canal (Bayard Ditch)	300	13	4	16,000	7,200	
K. Canals	160	13	4	8,320	3,744	
Total	1,697	....	....	91,320	41,094	

The material removed, which will consist mainly of mud, must be deposited on the banks of the creek.

THE ENTRANCE.

The distance from the entrancet o 8 feet water in the Delaware Bay is 3,500 feet, with an average depth of 2½ feet at low-water.

To dredge a channel 75 feet wide and 7 feet deep across the shoal will require the removal of 45,000 cubic yards of material at a probable cost of 30 cents per yard, amounting to $13,500.

The bottom seems to be soft mud on the surface, with probably some clay and sand underneath. At this point a close survey would be required before any improvements were commenced.

TIDES.

The mean rise and fall at entrance, 6.00 feet; the mean rise and fall at Odessa, 4.70 feet. Difference in time between high-water at Odessa and entrance, 2 hours 15 minutes.

This creek is in the collection district of Delaware; Saint Augustine range lights are the nearest light-houses, and Fort Delaware is the nearest fortification.

* * * * * * *

Very respectfully, your obedient servant,

W. S. Edwards,
Assistant Engineer.

Col. J. N. Macomb,
Corps of Engineers, U. S. A.

Recapitulation of improvements and estimates.

	Amount to be removed.	Cost per cubic yard.	Whole cost.
	Cubic yards.		
Dredging shoals	20,875	$0 50	$10,488 00
Widening canal	14,000	45	6,300 00
Canals	91,320	45	41,094 00
Entrance	45,000	30	13,500 00
Totals	171,195		71,382 00

F 24.

EXAMINATION OF RIDLEY CREEK, DELAWARE COUNTY, PENNSYLVANIA.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., December 30, 1880.

SIR: I have the honor to forward herewith a tracing of the chart of Ridley Creek, Delaware County, Pennsylvania, made during the past season, in accordance with section 2 of the river and harbor act of June 14, 1880.

The extensive plant of the print works, operated by the Eddystone Manufacturing Company, occupies about 30 acres near the mouth of the creek. The remaining lands bordering on the creek in this vicinity belong to William Simpson & Sons, who are also proprietors of the print works. They are now engaged at their own expense in improving the navigation by deepening it and altering its course with the view of straightening it; this is being done under an order of court of Delaware County, in compliance with laws of Pennsylvania. For this reason, no project or estimate is submitted for the improvement of the navigation by the United States.

COMMERCIAL STATISTICS.

The business of the creek, as ascertained, is as follows:

The Eddystone Print Works employ about 600 people and produce about 60,000,000 yards of prints per annum. Much of their heaver freight is transported by water, as follows:

9 sloops, coal, 398 tons.
29 sloops, wood, 954 cords.
75 barges, coal, 16,761 tons.
4 barges, lumber, 875 tons.
5 schooners, lumber, 1,880 tons.
872 steamboats, miscellaneous, 10,000 tons.

In addition to the above 9 sloops and 60 barges are regularly engaged in carrying stone, sand, coal, &c., to and from various points on the creek.

The draught of the vessels engaged in this traffic is from 5 to 7 feet.

Very respectfully, your obedient servant,

J. N. MACOMB,
Col. of Engineers.

To the CHIEF OF ENGINEERS, *U. S. A.*

F 25.

EXAMINATION OF LITTLE CREEK, IN KENT COUNTY, DELAWARE.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., December 31, 1880.

SIR: I have the honor to forward herewith a report and tracing of chart of Little Creek, Delaware, in accordance with section 2 of river and harbor act of June 14, 1880.

The navigation is about 3½ miles in length, terminating at Little Creek Landing.

The improvement estimated for is to obtain 6 feet at low-water. The shoals with less depths than this aggregate about one mile, and their removal involves dredging about 17,000 cubic yards.

Some of the bends in the stream, especially that below Taylor's Gut, are so sharp as to interfere with the navigation, particularly of steam-vessels. The cut-offs given in the report are desired by those interested.

The entrance offers difficulties similar to those existing at other points. The distance from the mouth to 7 feet at low-water in the bay is about 1,500 yards across shoals of sand and mud, with 3 feet of water over them. The greater rise of tide at the mouth in great degree compensates for this, and the removal of the shoals in the creek itself is the great desideratum.

Very respectfully, your obedient servant,

J. N. MACOMB,
Colonel of Engineers.

To the CHIEF OF ENGINEERS, *U. S. A.*

REPORT OF MR. W. S. EDWARDS, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Philadelphia, Pa., December 10, 1880.

COLONEL: I respectfully submit report of examination of Little Creek, Delaware, with approximate estimates for desired improvements and map of creek showing same.

Little Creek is situated in Kent County, Delaware; is a narrow tidal stream, about 8 miles in length, bordered by salt marsh as far up as the Landing, which is the head of navigation, 3½ miles from the mouth. It has a width of 180 feet at its mouth and 30 feet at the Landing, with an average width of 70 feet. It empties into the Delaware Bay 70 miles below Philadelphia, and 1½ miles south of Mahon's River lighthouse. Small vessels of 5½ feet draught are now able to go up to the Landing at high-water, and during the peach season there are 3 steamers running there, one to New York and two to Philadelphia. There are no bridges crossing the creek below the Landing; there is one at the Landing above the wharves with a draw of 34½ feet opening. The creek drains an area of about 25 square miles. The Landing is a small town of about 200 inhabitants, who are chiefly engaged in the oyster trade. It has a post-office, and is 5 miles from Dover, the nearest railroad station.

The improvements desired consist of deepening across some shoals in the creek, and four short canals cut at sharp bends, so that vessels of greater length can come up to the Landing. No improvement of the entrance is asked for, but it was examined. From the entrance to 7 feet water in the bay is a distance of 1,500 yards, and the greater part of that distance is across a shoal or bar of soft mud with only 3 feet on it.

I have made estimates for a channel of 6 feet depth at low-water from the mouth of the creek up to the Landing, with a width at the shoal places of 40 feet, or about two cuts of an ordinary dredge-boat. The localities at which dredging will be required are:

Name.	Length.	Width.	Depth.	Cubic yards.	Cost.	Remarks.
	Feet.	*Feet.*	*Feet.*			
Landing Shoal	600	40	2	2,000	$1,000	Estimated at 50 cents per yard.
Long Reach Shoal	650	40	2	2,200	1,100	
Shoal spots from Long Reach to Straight Ditch	1,000	40	2	3,400	1,700	
Lower Shoal	450	40	2	1,400	700	
Between Lower Shoal Canal and Taylor's Gut	600	40	2	2,000	1,000	
From Taylor's Gut to Cross Cut	100	40	2	300	150	
From Cross Cut to Double Gut Shoal	350	40	2	1,050	525	
Double Gut Shoal	1,500	40	2	4,500	2,250	
Total	5,250	......	......	16,850	8,425	

All the material removed at these points can be deposited on the banks of the creek, except at Double Gut Shoal, where scows could be used to advantage and dumped in the bay, as the creek is wide, and to place it on the bank would require the material to be handled twice.

The canals are as follows:

Name.	Length.	Width.	Depth.	Cubic yards.	Cost.	Remarks.
	Feet.	*Feet.*	*Feet.*			
Flat Iron	350	50	12	8,000	$3,600 00	Estimated at 45c. per yard.
Puncheon Gut	130	50	12	3,000	1,350 00	
Lower Shoal	200	50	12	4,500	2,025 00	
Taylor's Gut	160	50	12	4,000	1,800 00	
Totals	840	....	....	19,500	8,775 00	

TIDES.

	Feet.
Mean rise and fall at entrance	5.00
Mean rise and fall at Landing	3.20

Difference in time between high-water at Landing and entrance, 1 hour and 10 minutes.

These tides are from only two days' observations.

This creek is in the collection district of Delaware. Mahon's River light is the nearest light-house, and Fort Delaware is the nearest fortification.

At present there are no factories at Little Creek Landing. In case the improvements are carried out the erection of a large canning and fruit-drying factory is contemplated; that section of country being remarkably well adapted for the production of fruits and vegetables. The statistics of the oyster trade I could not obtain, owing to the vessels using Mahon's River as a harbor, although the vessels are all partly owned by citizens of the Landing, and also manned by them. There are about 20 oyster boats, ranging from 30 to 100 tons, each partially owned in this place.

Very respectfully, your obedient servant,

W. S. Edwards,
Assistant Engineer.

Col. J. N. Macomb,
Corps of Engineers, U. S. A.

Recapitulation of improvements asked for on Little Creek, Delaware.

	Cubic yards.	Cost.	Remarks.
Dredging to give 6 feet in channel	16,850	$8,425 00	Estimated at 50c. per yard.
Canals	19,500	8,775 00	Estimated at 45c. per yard.
Totals	36,350	17,200 00	

F 26.

SURVEY OF ABSECOM INLET, ATLANTIC COUNTY, NEW JERSEY.

Section 2 of the river and harbor act of June 14, 1880, directed a survey of this inlet, presumably with the view to an examination of its capabilities as a harbor.

The field work of the survey, consisting of topography and hydrography, and a gauging of the tidal currents, was completed in August and September, 1880, and the chart since prepared, a tracing of which is transmitted herewith.

The report of the gauging, by Mr. George Daubeney, civil assistant, is also forwarded, and its publication recommended as containing valuable data for future study.

The coast of New Jersey from Sandy Hook to Cape May is 125 miles in length, and presents the characteristics, common to the Atlantic south of Montauk Point, of a long narrow sand beach, separated from the mainland by interior bays and thoroughfares of greater or less extent. The bays are usually shallow and bordered by extensive marshes. The connecting thoroughfares are narrow and tortuous, but the tidal currents traversing them maintain a depth sufficient for a restricted navigation.

The long, narrow sea barrier is broken at intervals into separate "beaches" by inlets through which the tides ebb and flow. These inlets are variable, both in depth and position, from the mobility of the sand that constitutes their beds and banks, under the influence of waves and currents.

The principal are five in number, with low-water entrances ranging from 7 to 10 feet, increasing at high-water to 11 and 15. Of these, Absecom ranks second in depth, only New Inlet (Little Egg Harbor) exceeding it in capacity.

In none of these is an entrance safe in stormy weather, unless the master of the vessel is well acquainted with the locality, and has visited it within a comparatively short time.

The great increase in the number of coasters passing the New Jersey coast, and the frequent disasters to shipping, from being forced upon the beach in gales, suggest the desirability and future necessity for some harbors of refuge that by means of permanent engineering works shall be so fixed, both in position and depth, as to admit of their being suitably lighted and entered with safety by at least the smaller classes of trading vessels.

Nor in this matter of harbors of refuge does it necessarily follow that the interests of local trade merely should control either their construction or preservation, since the benefit would accrue to all coasters seeking shelter therein, from whatever port they may have sailed.

The general considerations determining their location are—

1. The necessity for their construction; and
2. The selection of such points as present the best natural advantages.

Absecom Inlet is about 75 miles south of Sandy Hook, and 50 miles north of Cape May, and separates Absecom Beach from Brigantine Beach. Its channel of entrance bears about north-northwest, with 8 or 9 feet least depth at low-water, and for two or three years past has exhibited an unusual stability in depth and direction.

After crossing the bar 1½ miles from shore the channel deepens, until between the beaches the low-water depth is over 60 feet. The (comparatively sheltered) area bounded by the 25-foot contour is some 1,200 yards in length by 150 or 175 yards wide, and constitutes the present harbor. Thence the waters diverge westward into Absecom Channel, which has a long stretch of 17 to 20 feet, and eastward into Brigantine Channel with 10 to 13 feet.

On the accompanying chart the position of the gauging sections is indicated; also the shore lines of 1854 and 1876, showing the considerable changes that have taken place.

In 1878 the dangerous encroachment of the sea led the Light-House Establishment to construct a stone jetty, under the direction of General Raynolds, Corps of Engineers, for the protection of the light-house site and grounds. The effect was almost immediate in arresting the erosion of the shore; and the accretions below the jetty have since been, and are still, apparently increasing.

It is no doubt feasible to improve the entrance by means of suitable jetties, but the preparation of plans and estimates for these does not appear to be called for in this preliminary report.

Further observation of the changes in progress, and a resurvey of the locality during the ensuing season, are desirable, if further study of this harbor should be called for.

It may be stated that, even if improvements shall not be immediately contemplated, a certain care might be exercised to protect the few existing natural inlets against avoidable injury.

In this view of the case, when it was brought to the attention of this office that a project was under consideration, by authority of a State charter, and proposals asked for the construction of a railroad trestle and swing bridge to connect Absecom and Brigantine beaches, the facts were reported to the department in letter of April 19, 1881, from which the following extracts are made:

> Attempts are making by persons interested in the coasting trade to secure the construction by the United States of harbors "(on the New Jersey coast)" which, at any rate, for moderate draughts, shall have the degree of stability necessary to their usefulness. It is probable that the survey of Absecom Inlet was ordered with some such end in view. As it is, this inlet is one of the best natural harbors on the New Jersey coast, the channel depth being about 8 to 9 feet at low-water, and exhibiting a very considerable degree of permanency, both in depth and position, for the last two or three years.
>
> The construction of a railroad trestle or other bridge across the inlet would practically destroy it as a harbor of refuge. The draw would be a useful feature enough under ordinary circumstances, but at such times as the inlet would be needed as a harbor of refuge the bridge would be a dangerous impediment.

The proposed location of the bridge is shown on the chart accompanying this report. Owing to the non-receipt of acceptable proposals, and the lateness of the season, the construction of this bridge has been postponed until next year.

If observation of this harbor is to be continued, an appropriation of $2,500 for a resurvey during the summer of 1882 is recommended.

REPORT BY MR. GEORGE DAUBENEY, ASSISTANT ENGINEER, UPON TIDAL CURRENTS THROUGH ABSECOM INLET.

PHILADELPHIA, *October* 20, 1880.

COLONEL: In acccordance with your instructions to gauge the inflow and outflow of water at Absecom Inlet, I respectfully submit the following report:

The points selected for gauging, namely, Brigantine and Absecom Channels, were taken in preference to the channel (commonly called "The Inlet") between Brigantine Beach and Atlantic Beach, on account of the great depth of its water and of the chance of being fouled by the great number of sailing craft constantly passing. The localities selected are greatly deficient in some of the features usually required, most especially in uniformity of cross-section immediately above and below them. Owing to the great irregularities in the channel-ways, this was unavoidable. Two cross-sections, 100 feet apart, were sounded out in each channel, the up-stream one being occupied during ebb currents and the down-stream one during floods, the floats thus passing over the same ground in both cases. The cross-sections having been sounded out, and the location and number of points on them to be gauged having been selected, two of these points were occupied during the same current, it being taken for granted that the amount of water passing any two given points on a cross-section during the same current always bear the same proportion to one another, irrespective of the range of tide. The velocity midway between the surface and bottom was assumed to nearly equal the mean velocity of a current in any vertical plane. This velocity was measured by means of a subsurface float. A keg, 16 inches high and 10 inches head diameter, having both heads removed and being weighted on its lower edge, was suspended from the center of its bung diameter by a line ⅛ inch diameter from a surface float of cork 8 inches square and 3 inches deep. A line ⅛ inch in diameter, by which the distance run by the float was measured, was run off a log reel from a boat moored fast stem and stern.

The assumption that the mid-depth velocity nearly equalled the mean velocity in any vertical plane was tested on an ebb current, the mid-depth, the surface, 4 feet below the surface, 8 feet below the surface, 12 feet below the surface, and the bottom velocities being all measured within 5 minutes. The results are given below.

Velocities in 10 seconds in feet.

Time when measurements were made.	Surface.	4 feet below surface.	8 feet below surface.	12 feet below surface.	Bottom.	Mid-depth.
11. 35 to 11. 40	13¼	14	12	13½	11	11¼
11. 40 to 11. 45	14	13¼	13	16¼	13	15
11. 45 to 11. 50	15¼	14¼	13½	13	14¾	21
11. 50 to 11. 55	16¾	15¼	16½	13	14½	13
11. 55 to 12. 00	17	15¾	17½	15	16½	17
12. 00 to 12. 05	19	17	15½	19	13½	15½
12. 05 to 12. 10	16	16½	15¼	18¼	13	14
12. 10 to 12. 15	14½	15½	19	16	17¾	17½
12. 15 to 12. 20	18	15	15¾	17¼	14	17½
12. 20 to 12. 25	19	17	17½	19	21½	18
12. 25 to 12. 30	18½	15½	17¼	17	15½	16
12. 30 to 12. 35	18½	16	17¼	17¾	17	17¼
12. 35 to 12. 40	16	17¾	16	16½	14	16¾
12. 40 to 12. 45	21	17	14	15¾	17½	18
12. 45 to 12. 50	22	18	15	15¼	18¼	17
12. 50 to 12. 55	21	22	15½	21½	13½	21
12. 55 to 1. 00	20	19¼	16¼	16	15¾	16¼
1. 00 to 1. 05	19½	19¼	17	15	14¼	17½
1. 05 to 1. 10	17¾	19¾	17¼	17½	15	18½
1. 10 to 1. 15	19	18¼	15¾	17½	13½	19
1. 15 to 1. 20	20	14¼	15¾	16	13½	16¾
1. 20 to 1. 25	19½	16¼	15	15½	15½	16¾
1. 25 to 1. 30	19	15¼	14	15	14½	14¾
1. 30 to 1. 35	17½	17½	15	15	15½	17
1. 35 to 1. 40	17	15	18	17¼	15¾	15¾
1. 40 to 1. 45	16½	17	17	15	13½	17
1. 45 to 1. 50	19¼	20½	16	14	11	17¼
1. 50 to 1. 55	18¾	16	15¾	16½	16	17
1. 55 to 2. 00	17	16¾	17½	14	15¼	16½
2. 00 to 2. 05	18½	16¾	15	15	13¾	17½
2. 05 to 2. 10	17	14	15¼	14¼	15¼	17½
2. 10 to 2. 15	15½	15¼	15	17¼	14¾	14
2. 15 to 2. 20	16½	16	15¼	13¼	13½	17
2. 20 to 2. 25	15½	14¾	13	12½	14¾	14¾
2. 25 to 2. 30	14	14	12	13¼	11¼	13½
2. 30 to 2. 35	13¼	16¾	15	14½	10	15½
2. 35 to 2. 40	14¾	17	16	12¼	15½	12¾
2. 40 to 2. 45	15¾	15¼	14¼	12½	12½	15
2. 45 to 2. 50	13¾	15	13	13¾	11½	13½
2. 50 to 2. 55	15½	14¼	10½	11¾	12½	12¾
2. 55 to 3. 00	14¼	13	14	14¼	13	13¼
3. 00 to 3. 05	13½	13	11½	10½	12	13
3. 05 to 3. 10	14	13	12	11½	9	12
3. 10 to 3. 15	14¼	13¼	14	10¾	13	11½
3. 15 to 3. 20	14	12¾	13½	11½	10½	12¼
3. 20 to 3. 25	13¼	11	12¾	11½	10	11¾
3. 25 to 3. 30	11¼	11	13	11¼	10	10
3. 30 to 3. 35	12¼	10½	10¼	11½	9¼	12
Totals	797¼	751¼	716	711¼	666¼	745¾
Average velocities	16. 6083	15. 6510	14. 9166	14. 8166	13. 8792	15. 5365

Taking these average velocities and obtaining the mean.

Average velocity, surface	16.6083
Average velocity 4 feet below	15.6510
Average velocity 8 feet below	14.9166
Average velocity 12 feet below	14.8166
Average velocity, bottom	13.8792
	5)75.8717
	15.1743 = mean.

Mid-depth = 15.5365.
Mean = 15.1743.
Excess of mid-depth over mean, 2.3 per cent.

It is possible that this excess of 2.3 per cent. might be lessened could the bottom velocities be obtained with any certainty. The total velocities registered for the bottom will be below the real total, it being almost impossible to detect when the float slightly grazes the bottom.

This test was made at Station 2, Absecom Channel, two boats being unable to gauge any greater depth at depths of 4 feet in 5 minutes of time, and it is impossible to pick up a third boat's crew who are capable of making such measurements without some preliminary training. A partial test was made during a flood current at Station 2 in Brigantine Channel at every 5 feet in depth, for a period of three hours, with the following result:

Average velocity, surface	23.7777
Average velocity 5 feet below surface	22.9583
Average velocity 10 feet below surface	22.3125
Average velocity 15 feet below surface	24.5486
Average velocity 20 feet below surface	23.7708
Bottom 3 to 5 feet below last depth	00.0000
	5)117.3679
	23.4736 = mean.

Mid-depth = 24.8333.
Mean = 23.4736.
Excess of mid-depth over mean, 5½ per cent.

The intention was, at starting on this test, to measure the bottom velocity also, but the two boats' crews were unable to do it in the requisite 5 minutes of time.

The loss of one of the floats at the end of three hours stopped further measurements. It is to be noticed that the highest velocities were from mid-depth to bottom, and it is evident that a measurement of the bottom velocity would have increased the mean average, and consequently have decreased the 5½ per cent. excess of the mid-depth average.

The reason for the bottom velocities being the highest, is doubtless owing to the fact of the westerly channel of the Brigantine cross-section, where the test was applied, being closely confined by the middle shoal, and to the steep inclination of the bottom, which shoals from 25 to 12 feet in about 1,000.

BRIGANTINE CHANNEL.

The cross-sections of this channel show a shoal in the center of the water-way, with deep water on both sides of it. The deep water on the east side is maintained by the ebb current and on the west by the flood. This latter channel, although the deeper of the two, is, to a great extent, closed a few hundred feet up stream of the cross-section, which is shown on sheet A. The width between the high-water marks is 1,700 feet, and between the low-water marks 1,480 feet, of which the center shoal or middle ground occupies one-third, the other two-thirds being about equally divided between the two side channels. Seven stations were occupied on this cross-section; three in the westerly or flood channel, one on the crest of the middle shoal, and three in the easterly or ebb channel.

The mid-depth velocities at these seven stations during ebb and flood currents are shown on sheets B, C, D, E, F, G, H. The velocities taken every 5 minutes for 10 seconds are plotted to a scale of distance and time, and show how long after the middle of stand of low or high water the currents set up or down; also their duration and time of ceasing as regards high or low water on shore. The stations are numbered 1, 2, 3, 3½, 4, 5, and 6; 1, 2, and 3 being in the westerly or flood channel, 3½ on the crest of the middle shoal, and 4, 5, and 6 in the easterly or ebb channel. The simultaneous occupation of two of these current stations shows difference between them in time as regards the setting up or down of currents, and also in their cessation.

TAKING THE FLOODS.

Stations 1 and 2 set up simultaneously.
Station 3 sets up 10 minutes after Station 2.
Station 3½ sets up simultaneously with Station 3.
Station 4 sets up 35 minutes after Station 3.
Station 5 sets up 5 minutes after Station 4.
Station 6 simultaneously with Station 5.

This would seem to show that there is a difference of 50 minutes in time between the setting up of a flood current on the west side of the channel at Station 1, and on the east side at Station 6.

REGARDING THE CESSATION OF THE FLOOD CURRENT.

Stations 1 and 2 cease simultaneously.
Station 3 ceases 10 minutes earlier than Station 2.
Station 3½ ceases simultaneously with Station 3.
Station 4 ceases 10 minutes earlier than Station 3.
Station 5 ceases 10 minutes earlier than Station 4.
Station 6 ceases 45 minutes earlier than Station 5.

This seems to imply that the flood current runs up at Station 1, under the west bank, 75 minutes longer than at Station 6, under the east bank.

TAKING THE SETTING DOWN OF THE EBB CURRENTS.

Station 5 sets down 20 minutes later than Station 6.
Station 4 sets down 5 minutes later than Station 5.
Station 3½ sets down 5 minutes earlier than Station 3.
Station 3 sets down 5 minutes later than Station 4.
Station 2 sets down 5 minutes later than Station 3.
Station 1 sets down 10 minutes later than Station 2.

This shows the ebb current to set down under the east bank, at Station 6, 45 minutes earlier than under the west bank at Station 1.

AS TO THE CESSATION OF THE EBB CURRENT.

Station 5 ceases 5 minutes later than Station 6.
Station 4 ceases 5 minutes earlier than Station 5.
Station 3½ ceases 25 minutes later than Station 3.
Station 3 ceases 45 minutes earlier than Station 4.
Station 2 ceases 5 minutes earlier than Station 3.
Station 1 ceases 20 minutes earlier than Station 2.

This would seem to show that the ebb current continues running down at Station 6, on the east bank, 75 minutes longer than at Station 1, under the west bank.

The greatest difference of time in the movement of the current at any of the intermediate stations is between Stations 3 and 4.

That difference at setting up of flood was 35 minutes against Station 4.
That difference at cessation of flood was 10 minutes against Station 4.
That difference at setting down of ebb was 5 minutes against Station 3.
That difference at cessation of ebb was 45 minutes against Station 3.

This shows the influence of the middle shoal to be much greater at the time of low-water than at high. These stations were 480 feet apart. On the crest of the middle shoal, Station 3½ was occupied only 120 feet from Station 4, and observed simultaneously with Station 3. The comparison shows the same difference between 3½ and 4 on the flood-currents, but lessens the difference on the ebbs, making the current set down at the same time as at Station 4, and cease 20 minutes earlier.

The flood-currents set up apparently from 15 to 40 minutes after mid-stand low-water, and cease from 40 to 80 minutes after high-water. This applies to Stations 1 and 2, which may be considered representative flood stations.

The ebb sets down from 40 to 55 minutes after mid-stand of high-water, and ceases from 65 to 75 minutes after mid-stand of low-water. This applies to Station 5, which may be considered a representative ebb station.

The height of the rise or fall of the tide on shore, at the time that the currents change, is governed by the duration of the high or low-water stands.

The above-mentioned differences of time in the duration of the same currents, at the various stations on the cross-section, prevent the obtaining of proportional velocities for each quarter of the current, and necessitate dealing with the current as a whole.

The following table gives the results of the measurements at the several stations:

TABLE A.—*Flood currents.*

Station.	Date.	Mean velocity per second during current.	Duration of currents.	Total discharge during current per square foot of area.
		Feet.	*Seconds.*	*Cubic feet*
1	August 28	1.4530	23,100	33,5[illegible]
2		1.3310	23,100	30,74[illegible]
2	August 29	1.2240	24,900	30,47[illegible]
3		1.1790	23,700	27,[illegible]
3	September 15	1.6250	24,300	39,4[illegible]
3½		1.3310	24,300	32,3[illegible]
3	September 2	1.4560	24,000	34,9[illegible]
4		1.6730	21,800	3[illegible]
4	September 1	1.5560	21,600	33,[illegible]
5		1.0420	20,700	21,5[illegible]
5	August 30	0.9093	21,300	19,3[illegible]
6		0.3913	18,600	7,2[illegible]

From the total discharges in cubic feet during the current per square foot of area, proportions are obtained between the stations gauged simultaneously as per following table:

TABLE B.—*Flood currents.*

Stations.	Date.	
Station 1	Aug. 28	1.0000
2		0.9160
2	Aug. 29	1.0000
3		0.9168
3	Sept. 15	1.0000
3½		0.8191
3	Sept. 2	1.0000
4		1.0200
4	Sept. 1	1.0000
5		0.6418
5	Aug. 30	1.0000
6		0.3758

Having obtained the proportions between the discharges per square foot of area, at the stations gauged simultaneously, proportions are again obtained from them with any one of the stations which may be selected to represent unity. In the case of the floods Station 1 has been selected, there being the greatest discharge at that station, as by the following table:

TABLE C.—*Flood.*

Stations.	
Station 1	1.0000
2	0.9160
3	0.8398
3½	0.6879
4	0.8564
5	0.5496
6	0.2066

The results of the measurements during the ebb-current at the several stations are shown on the next table:

TABLE D.—*Ebb-current.*

Station.	Date.	Mean velocity per second during currents.	Duration of currents.	Total discharge during current per square feet of area.
		Feet.	*Seconds.*	*Cubic feet.*
1	August 24	0.7821	18,600	13,617
2		1.2850	20,400	26,214
2	August 25	0.9368	21,600	20,224
3		0.8413	22,200	18,677
3	September 5	0.9641	17,700	17,065
3½		1.0090	19,500	19,676
3	September 3	0.6628	18,600	12,328
4		1.5790	21,900	34,580
4	August 23	1.7810	23,700	42,209
5		2.4080	24,300	58,514
5	September 4	2.1690	23,100	50,104
6		1.5510	24,000	37,224

Pursuing the same course as with the floods, we obtain the two following tables:

TABLE E.—*Ebb-current.*

Stations.	Date.	
Station 1	August 24	0.5195
2		1.0000
2	August 25	1.0828
3		1.0000
3	September 5	1.0000
3½		1.1529
3	September 3	0.3565
4		1.0000
4	August 23	0.7214
5		1.0000
5	September 4	1.0000
6		0.7429

Selecting Station 5 to represent unity, we obtain—

TABLE F.—*Ebb-current.*

Stations.	
Station 1	0.1447
2	0.2785
3	0.2572
3½	0.2965
4	0.7214
5	1.0000
6	0.7429

From Tables C and F curves were constructed (see Sheet A) showing the proportional inflow and outflow per square foot of area across the channel during an entire current, the ordinates at Station 1 on the flood and Station 5 on the ebb being 1.0000. These curves have been subdivided to agree with the number of divisions, namely, 16, into which the cross-section area has been divided. The water-level used in obtaining the areas was 2 feet above mean low-water, being one-half of the mean rise and fall of 4 feet as determined by 34 high and low water readings at the inlet. As none of the tides observed whilst gauging the various stations happened to be a mean, four have been selected for comparison—one flood and one ebb having a range a little above the mean, and one flood and one ebb having a range a little below it:

	Range.	Reference to mean.	
Flood, September 15	4′ 30	L. W. 0.00	H. W. + 0.30
Ebb, September 5	4′ 20	H. W. + 0.05	L. W. − 0.15
Flood, September 2	3′ 75	L. W. + 0.20	H. W. − 0.05
Ebb, September 4	3′ 65	H. W. − 0.35	L. W. 0.00

Inspecting the flood-current of September 15, we find that Stations 3 and 3½ were gauged on that day.

Selecting the inflow per square foot of area at Station 3, namely, 39,488 cubic feet (see Table A), and applying the proportion that the inflow at that station bears to that of Station 1, namely, 0.8398 (see Table C) we find the inflow per square foot of area at Station 1, or unity, to be (39,488 × 10.8398) 47,020 cubic feet.

A similar inspection of the ebb-current of September 5 shows that Stations 3 and 3½ were gauged on that day.

Selecting the outflow at Station 3 per square foot of area, namely, 17,065 cubic feet (see Table D), and applying the proportion that the discharge at that station bears to Station 5, or unity, namely, 0.2572 (see Table F), we find the discharge per square foot of area at Station 5, or unity, to be (17,065 × 10.2572) 66,347 cubic feet.

Inspecting the flood current of September 2, it is found that Stations 3 and 4 were gauged on that day. Selecting the inflow per square foot of area at Station 3, namely, 34,944 cubic feet (see Table A), and applying the proportion that the inflow at that station bears to Station 1, or unity, namely, 0.8398 (see Table C), we obtain the inflow per square foot of area at Station 1, namely, 41,610 cubic feet (34,944 × 10.8398).

Again, inspecting the ebb-current of September 4 we find that Stations 5 and 6 were gauged on that day.

Selecting the outflow per square foot of area at Station 5, namely, 50,104 cubic feet (see Table D), we already have the discharge at unity, it being represented by Station 5 on the ebb.

Having the discharge in cubic feet per square foot of area at unity, *i. e.*, Station 1 during floods and Station 5 during ebbs, and applying to it the mean proportion found by the curves of proportional discharge per square foot of area (see Sheet A), we are enabled by multiplying their product by the area of the cross-section to obtain the inflow or outflow of the entire stream. The following are the results when applied to the above-mentioned tides:

Total inflow, flood-current, September 15, 946,558,156 cubic feet; range of tide.. 4′.30
Total inflow, flood-current, September 2, 837,642,261 cubic feet; range of tide .. 3′.75
Total outflow, ebb-current, September 5, 792,898,419 cubic feet; range of tide .. 4′.20
Total outflow, ebb-current, September 4, 599,533,419 cubic feet; range of tide .. 3′.65

A mean of these currents may be fairly assumed to give approximately the flow and ebb of current for an average tide of 4′ range.

Then mean flood = 892,100,209 cubic feet.
mean ebb = 696,215,919 cubic feet.

ABSECOM CHANNEL.

There was even greater difficulty in obtaining a suitable cross-section in this channel than in Brigantine, and the best location that could be found was across a deeply-scoured hole off Rum Point. The cross-section (shown on Sheet I) has a width, between the high-water marks, of 1,405 feet, and between the low-water marks, of 925 feet. On the south side of the cross-section a mud flat, bare at low-water, runs out for a distance of 450 feet.

The bottom then drops off and runs down with moderate regularity to a depth of from 30 to 35 feet close under the north bank, which is nearly vertical.

Measurements were made of the inflow and outflow at four stations on the cross-section, the most southerly one being about 200 feet from the low-water mark on the above-mentioned mud flat, and the most northerly one about 135 feet from the north bank in the deepest water. The mud flat extends about one-third of the entire width of the channel into the water-way, having but a slight current over it during either flood or ebb. The greatest velocity during both currents was at Station 4. The difference of time in the setting up or down of currents between the opposite sides of the channel is much less than in Brigantine.

Taking the flood current it sets up at Stations 4 and 3 simultaneously.

At Station 3, 5 minutes earlier than at Station 2.

At Station 2, 15 minutes later than at Station 1.

Making a difference in time between the south and north banks of 10 minutes in the setting up of the current in favor of the former.

As regards the cessation of the flood-current it ceases simultaneously at Stations 4 and 3 (5 minutes earlier at Station 2 than at Station 3, and simultaneously at Stations 2 and 1), making a difference in time between the south and north banks of 5 minutes in the duration of current in favor of the latter.

Taking the ebbs, the current sets down at Stations 4, 3, and 2 simultaneously, and at Station 1 on the south side 10 minutes earlier.

The ebb ceases 20 minutes earlier at the south bank than at the north bank.

The mid-depth velocities taken every 5 minutes at the four stations throughout flood and ebb currents are plotted to a scale of distance and time on Sheets K, L, M, and N. The results of the measurements made during the floods are given in the following table:

TABLE G.—*Flood-currents.*

Station.	Date.	Mean velocity per second during current.	Duration of current.	Total inflow during current per square foot of area.
		Feet.	*Seconds.*	*Cubic feet.*
4	September 11	2. 1180	23. 400	49. 561
3		1. 2740	23. 400	29. 812
3	September 12	1. 3810	24 000	33. 144
2		0. 9601	23. 400	22. 466
2	September 13	1. 2170	24. 300	29. 573
1		0. 8162	25. 200	20. 568

Pursuing the same method as with Brigantine, two tables of proportions are obtained from the above, as follows:

TABLE H.—*Flood-current.*

Stations.	Date.	
Station 4	Sept. 11	1. 0000
3		0. 6015
3	Sept. 12	1. 0000
2		0. 6778
2	Sept. 13	1. 0000
1		0. 6995

From this table another is obtained:

TABLE K.—*Flood-current.*

Stations.	
Station 4	1. 0000
3	0. 6015
2	0. 4077
1	0. 2836

The measurements taken during the ebb-currents are given below.

TABLE L.—*Ebb-currents.*

Station.	Date.	Mean velocity per second during current.	Duration of current.	Total outflow during current per square foot of area.
		Feet.	*Seconds.*	*Cubic feet.*
4	September 6	1. 7960	21, 900	39, 332
3		1. 5430	21, 900	33, 792
3	September 18	1. 5620	21, 600	33, 739
2		1. 4370	21, 300	30, 608
2	September 22	1. 1760	22, 500	26, 460
2	September 17	1. 4180	21, 000	29, 778
1		0. 8461	20, 700	17, 514

From this table the following is obtained:

TABLE M.—*Ebb-current.*

Stations.	Date.	
Station 4	Sept. 6	1. 0000
3		0. 8591
3	Sept. 18	1. 0000
2		0. 9072
2	Sept. 17	1. 0000
1		0. 5882

From this is again derived—

TABLE N.—*Ebb-current.*

Stations.	
Station 4	1. 0000
3	0. 8591
2	0. 7794
1	0. 4584

From Tables K and N, flood and curves were constructed showing the proportional inflow and outflow per square foot of area during a current, unity being represented by Station 4 in both cases. None of the tides observed whilst gauging the several stations in this channel, happen to be a mean, 2 therefore, 1 flood and 1 ebb, having a range of 4′.55, have been selected for comparison, namely:

	Range.	Reference to mean.	
		L. W.	H. W.
Flood, September 11	4′. 55	—0. 40	+0. 15
		H. W.	L. W.
Ebb, September 18	4′. 55	—0. 10	—0. 65
Ebb, September 22	3′. 95	—0. 30	—0. 25

Another has been selected as giving approximately a discharge for a mean current. Inspecting the flood of September 11 it is found that Stations 4 and 3 (Table G) were gauged on that day. The inflow of water per square foot of area at Station 4, viz, 49,561 cubic feet, is therefore that at unity, it being represented by that station.

Inspecting the ebb of September 18, it is found that Stations 3 and 2 were gauged on that day. Selecting the discharge at Station 3 per square foot of area, namely, 33,739 cubic feet (Table L), and applying to it the proportion it bears to unity, namely, 0.8591 (Table N), the discharge per square foot of area is found to be 39,273 for Station 4, or unity.

The ebb of September 22 was gauged at Station 2, taking the discharge there per square feet of area 26,460 cubit feet (Table L) and applying the proportion in Table N, namely, 0.7794, we obtain 33,949 cubic feet discharge at Station 4, or unity. Following the same method as used on Brigantine Channel, multiplying the product of the discharge per square feet of area at the station representing unity and the mean proportion for any divisions obtained from the curve of proportional discharges (Sheet I) by the area of such divisions, the following results are obtained for the above-mentioned tide:

Total inflow of flood-current September 11, 561,923,311 cubic feet; range of tide.. 4.'55
Total outflow ebb-current September 18, 553,410,805 cubic feet; range of tide.. 4.'55
Total outflow ebb-current September 22, 478,396,131 cubic feet; range of tide.. 3.'95

This would seem to show that in Absecom Channel the inflow and outflow for tides of the same range may be considered equal with light winds, the difference between the tides of September 11 and 18 of about 1½ per cent. being attributed to the slightly increased height as regards mean levels attained by the flood of the 11th. (See page 20.)

The volume of water voided by the ebb of September 22 is probably slightly less than that of a mean tide of 4 feet, the range being 0.'05 less, and the low and high water levels lower than those of the mean. (See page 20.)

Taking the discharge of this ebb of the 22d, namely, 478,396,131 cubic feet, and applying to the proportion between the total areas of the two channels, namely, $\frac{\text{24,974 square feet for Brigantine}}{\text{17,975 square feet for Absecom}}$, it would give a discharge for Brigantine of 664,747,700 cubic feet, which is only 4 per cent. less than the volume 696,215,919 cubic feet obtained in that channel by measurement. (See page 14.)

The results obtained in the two channels would seem to show that in Absecom Channel the inflow and outflow for tidal currents of the same range and relative level are equal, and that in Brigantine Channel the inflow exceeds the outflow by 22 per cent.

	Cubic feet.
Absecom Channel average flood-current	478, 396, 131
Brigantine Channel average flood-current	892, 100, 209
Total inflow through inlet	1, 370, 496, 340
Absecom Channel average ebb-current	478, 396, 131
Brigantine Channel average ebb-current	696, 215, 919
Total outflow through inlet	1, 174, 612, 050

The wind on the days that the currents selected for computing discharges were gauged was light on all occasions, with the exception of September 15, during a flood in Brigantine Channel, when it was fresh from northwest. From its direction this wind would have a tendency to obstruct the inflow into Brigantine Channel, so cannot be held accountable in any way for the excess of flood over ebb water and may very possibly have decreased the percentage of that excess on that day, for we find that, on comparison, during the neaps of September 2 and 40 was 29 per cent., with light winds, whilst during the springs of September 15 and 5, with a fresh adverse wind on the 15th, the excess is only 16 per cent.

The great influence of strong winds upon the inflow is very clearly shown at Stations 3 and 2 in Absecom Channel, for we find that on September 11, at Station 3, with a tidal range of 4.'55 and light northwest wind, the average inflow per square foot of area was 29,812 cubic feet whilst on the 12th, with a tidal range of 4.'10 only and a strong southwest wind the inflow was 33,144 cubic feet, an increase of ten per cent., the duration of tide increasing from 6 hours 45 minutes on the 11th, to 6 hours 55 minutes on the 12th.

Again, at Station 2, on September 12, with a tidal range of 4.'10 and strong southwest wind the inflow per square foot of area was 22,466 cubic feet, whilst on September 13, with a tidal range of only 3.'95 and a very strong south wind, the inflow was 29,573 cubic feet, an increase of no less than 24 per cent., the duration of tide increasing from 6 hours 55 minutes on September 12, to 7 hours 10 minutes on September 13.

From this it may be inferred that winds of any strength disturb to a great extent the relations between the inflow and the outflow at Absecom and Little Egg Harbor, from both of which the interior bays are supplied, and that with strong southerly or southwesterly winds more water passes in at Absecom than on tides of greater range with winds in other directions. The fact that more water passes in at Absecom than flows out is, to some extent, supported by the relative duration of flood and ebb tides—observed whilst gauging.

Average duration of flood-tides, 6 hours 32 minutes.

Average duration of ebb-tides, 6 hours 07 minutes.

In computing the discharges the mid-depths have been taken as the mean, the 2¼ per cent. difference found to exist between them when measured being allowed to offset the difference in range and levels of tides used, they being below the mean.

EBB-CURRENTS OVER THE BAR.

The surface and bottom velocities were measured at four stations in the neighborhood of the bar, with the following results:

Station 1, on crest of bar; highest surface velocity 1.1 miles per hour; bottom .9 mile.

Station 2, at Bar Bouy; highest surface velocity .5 mile per hour; bottom .6 mile.

Station 3, half way between Stations 2 and 4; highest surface velocity 1.5 miles per hour; bottom 1.4 miles.

Station 4, at Channel Bouy; highest surface velocity 2.6 miles per hour; bottom 2.2 miles.

The velocities observed are plotted to a scale of distance and time on sheet O. They show that the currents on the bar set down from 30 to 40 minutes after middle of stand high-water at the inlet, and cease from 45 to 60 minutes after middle of stand low-water at the inlet. Stations 1 and 4 were occupied the same day during a spring-tide with a range of 4.′6, the wind being from the south. The highest velocity at Station 1, on the crest of the bar, was observed during the third quarter of the current, when it attained its maximum velocity of 1.1 miles an hour on the surface and about nine-tenths of a mile at the bottom. Stations 2 and 3 were occupied the same day during a neap-tide with a range of 3.′35, the wind being from the east. The high velocity shown at Station 1 in the third quarter of the current does not appear at Station 2, the adjoining station, where the maximum velocity was obtained during the second quarter, being about eight-tenths of a mile, at the surface and six-tenths at the bottom. Whilst lying at Station 2, it was noticed that the current was running much stronger some few hundred feet to the south of the station during the third quarter than at the station itself, namely, the bar bouy. This was no doubt the current that showed itself at Station 1, during the third quarter, its northerly edge probably striking that station being forced to the northward by the southerly wind then blowing. As the wind was east when Station 2 was occupied, this north edge of the current was forced more away to the southward, and the thick of the current instead of passing through the bar channel passed over the shoals to the south of it. With reference to the in-shore stations, 3 and 4, their maximum velocities appear to extend over the greater portion of the second and third quarters, Station 3 slacking up a little sooner in the third quarter. The surface and bottom currents at the in-shore Stations 3 and 4 seems to set in much the same direction at the off-shore Stations 2 and 1, the bottom generally set from one-half to one point to the southward of the surface, both of them, however, swinging with great irregularity.

There was considerable sea on, when these stations were occupied, and consequently great precision cannot be expected in either velocity or direction of current. The measurements were extended to a minute in time at the off-shore stations in hopes of neutralizing errors caused by motion of boat and float. The directions during each hour of current are tabulated below.

	Station 4, wind S.	Station 3, wind E.	Station 2, wind E.	Station 1, wind S.
First hour	SE. by S. ½ S. to SSE.	S.	ESE. to SE. by E.	E. by S. to SE. by E.
Second hour	SSE. to SE. by S.	S. to SE. by S	ESE. to SE. by E. ½ S.	SE. by E. to SE. by S.
Third hour	SE. by S. ½ S	SE. by S	ESE. ½ S. to SE	SE. to SSE.
Fourth hour	SE. by S. ½ S	SE. by S	SE. to E. SE. ½ S.	SE. to SE. by S.
Fifth hour	SE. by S. ½ S.	SE. by S. to SE. by E.	ESE. to SE	SE. by S. to SE. by E.
Sixth hour	SSE. to S. by E. and SE. by S.	SE. by E. to SE	SE. by E. to ESE.	SE. by E. to ESE.

As the method employed in gauging the inlet, a few words are perhaps necessary. Of course running the floats between ranges and observing the velocities from shore would be preferable to measuring them off a log-reel, but in the high velocities found in tidal waters the former method is not practicable, owing to the length of time consumed in picking up floats and letting them go again, especially as rapidity in making consecutive measurements is the most important feature in gauging tidal waters, an interval of 5 minutes being about the longest that should be allowed to lapse, owing to the rapidity and variableness of the changes in velocity. That the mid-depth velocity bears a close relationship to the mean, in some, if not all tidal waters, has been ascertained. The only point open to question in the method used in gauging Absecom Inlet is, whether the volumes of water passing any two given points on a cross-section always bear the same proportion to one another, irrespective of the range of tide. It is only reasonable to suppose that, putting aside the influence of high winds, such is the case. This chance of error can of course be overcome by occupying every station in a cross-section simultaneously.

In cross-sections of any great width this would necessitate the employment of a large number of boats, as in no case, if good results are required, should the stations be more than 200 feet apart. Also, if a mean discharge should be required, it would necessitate the repetition of such gauging for several days, until the discharge of a current of mean range of tide were obtained. These conditions complied with, there is no reason why the volumes of tidal waters cannot be gauged with a very close approximation to correctness.

As regards the effect of friction in taking the line off the reel, in high velocities it may be discarded, and in low velocities it can to a great extent be neutralized by a judicious feeding of the line off the reel by the persons tending it.

Very respectfully, your obedient servant,

G. DAUBENEY,
Civil Assistant.

Col. WILLIAM LUDLOW,
Corps of Engineers, U. S. A.

The computation of the tidal discharges referred to in this report are appended.

BRIGANTINE CHANNEL.

[Flood-current, September 15; range of tide, 4'.30; inflow in cubic feet per square foot of area at Station 1=47,020.]

Number of division.	Inflow in cubic feet at unity, or Station 1.		Mean proportion of division.		Area of division in square feet.		Inflow at division during current.
							Cubic feet.
I	47,020	×	0.030	×	110	=	155,166
II	47,020	×	0.108	×	755	=	3,834,017
III	47,020	×	0.225	×	2,159	=	22,841,210
IV	47,020	×	0.400	×	2,343	=	44,067,245
V	47,020	×	0.594	×	2,229	=	62,255,714
VI	47,020	×	0.773	×	1,902	=	69,130,968
VII	47,020	×	0.833	×	1,220	=	47,784,666
VIII	47,020	×	0.704	×	497	=	16,451,742
IX	47,020	×	0.725	×	613	=	20,892,067
X	47,020	×	0.770	×	702	=	25,410,350
XI	47,020	×	0.819	×	820	=	31,577,681
XII	47,020	×	0.854	×	1,029	=	41,319,619
XIII	47,020	×	0.879	×	1,806	=	74,643,104
XIV	47,020	×	0.941	×	2,929	=	237,314,754
XV	47,020	×	0.991	×	3,423	=	159,501,103
XVI	47,020	×	0.780	×	2,437	=	89,378,750
Total inflow							946,558,156

BRIGANTINE CHAFNEL—Continued.

[Ebb-current, September 5; range of tide, 4′.20; outflow in cubic feet per square foot of area at Station 5=66,347.]

Number of division.	Outflow in cubic feet at unity or Station 5.		Mean proportion of division.		Area of division in square feet.		Outflow at division during current.
							Cubic feet.
I	66, 347	×	0. 055	×	110	=	401, 402
II	66, 347	×	0. 366	×	755	=	18, 333, 798
III	66, 347	×	0. 761	×	2, 159	=	109, 009, 068
IV	66, 347	×	0. 962	×	2, 343	=	149, 544, 674
V	66, 347	×	0. 990	×	2, 229	=	146, 409, 427
VI	66, 347	×	0. 881	×	1, 902	=	111, 176, 349
VII	66, 347	×	0. 603	×	1, 220	=	48, 809, 101
VIII	66, 347	×	0. 288	×	497	=	9, 496, 674
IX	66, 347	×	0. 270	×	613	=	10, 981, 161
X	66, 347	×	0. 269	×	702	=	12, 528, 930
XI	66, 347	×	0. 262	×	820	=	14, 254, 065
XII	66, 347	×	0. 262	×	1, 029	=	17, 887, 077
XIII	66, 347	×	0. 269	×	1, 806	=	32, 232, 537
XIV	66, 347	×	0. 276	×	2, 929	=	53, 635, 555
XV	66, 347	×	0. 205	×	3, 423	=	46, 557, 000
XVI	66, 347	×	0. 072	×	2, 437	=	11, 641, 581
Total outflow							792, 898, 419

[Flood-current, September 2; range of tide, 3′.75; inflow in cubic feet per square foot of area at Station 1=41,610.]

Number of division.	Inflow in cubic feet at unity or Station 1.		Mean proportion of division.		Area of division in square feet.		Inflow at division during current.
							Cubic feet.
I	41, 610	×	0. 030	×	110	=	137, 312
II	41, 610	×	0. 108	×	755	=	3, 392, 868
III	41, 610	×	0. 225	×	2, 159	=	20, 213, 084
IV	41, 610	×	0. 400	×	2, 343	=	38, 996, 756
V	41, 610	×	0. 594	×	2, 229	=	55, 092, 436
VI	41, 610	×	0. 773	×	1, 902	=	61, 176, 760
VII	41, 610	×	0. 833	×	1, 220	=	42, 286, 407
VIII	41, 610	×	0. 704	×	497	=	14, 558, 733
IX	41, 610	×	0. 725	×	613	=	18, 492, 425
X	41, 610	×	0. 770	×	702	=	22, 491, 813
XI	41, 610	×	0. 819	×	820	=	27, 944, 387
XII	41, 610	×	0. 854	×	1, 029	=	36, 565, 294
XIII	41, 610	×	0. 879	×	1, 806	=	66, 054, 615
XIV	41, 610	×	0. 941	×	2, 929	=	210, 009, 223
XV	41, 610	×	0. 991	×	3, 423	=	141, 145, 603
XVI	41, 610	×	0. 780	×	2, 437	=	79, 094, 545
Total inflow							837, 642, 261

BRIGANTINE CHANNEL—Continued.

[Ebb-current, September 4; range of tide, 3′.65; outflow in cubic feet per square foot of area at Station 5=50,104.]

Number of division.	Outflow in cubic feet at unity or Station 5.		Mean proportion of division.		Area of division in square feet.		Outflow at division during current.
							Cubic feet.
I	50,104	×	0.055	×	110	=	303,122
II	50,104	×	0.366	×	755	=	13,845,255
III	50,104	×	0.761	×	2,159	=	82,320,961
IV	50,104	×	0.962	×	2,343	=	112,932,383
V	50,104	×	0.990	×	2,229	=	110,513,995
VI	50,104	×	0.881	×	1,902	=	83,957,308
VII	50,104	×	0.603	×	1,220	=	36,859,491
VIII	50,104	×	0.288	×	497	=	7,171,666
IX	50,104	×	0.270	×	613	=	8,292,711
X	50,104	×	0.269	×	702	=	9,461,522
XI	50,104	×	0.262	×	820	=	10,761,855
XII	50,104	×	0.262	×	1,029	=	13,507,912
XIII	50,104	×	0.269	×	1,806	=	24,341,180
XIV	50,104	×	0.276	×	2,929	=	40,494,859
XV	50,104	×	0.205	×	3,423	=	35,977,750
XVI	50,104	×	0.072	×	2,437	=	8,791,449
Total outflow							599,533,419

ABSECOM CHANNEL.

[Flood-current, September 11; range of tide, 4′.55; inflow in cubic feet per square foot of area at Station 4=49,561.]

Number of division.	Inflow in cubic feet at unity or Station 4.		Mean proportion of division.		Area of division in square feet.		Inflow at division during current.
							Cubic feet.
I	49,561	×	0.043	×	518	=	1,103,926
II	49,561	×	0.100	×	187	=	926,795
III	49,561	×	0.154	×	365	=	2,785,839
IV	49,561	×	0.241	×	796	=	9,507,630
V	49,561	×	0.318	×	1,116	=	17,588,629
VI	49,561	×	0.375	×	1,346	=	25,016,011
VII	49,561	×	0.427	×	1,884	=	39,870,458
VIII	49,561	×	0.506	×	2,417	=	60,613,662
IX	49,561	×	0.758	×	2,741	=	102,972,170
X	49,561	×	0.985	×	3,241	=	158,218,613
XI	49,561	×	0.909	×	3,068	=	138,185,030
XII	49,561	×	0.350	×	296	=	5,134,548
Total inflow							561,923,311

ABSECOM CHANNEL—Continued.

[Ebb-current, September 15; range of tide, 4'.55; outflow in cubic foot per square feet of area at Station 4 = 39,273.]

Number of division.	Outflow in cubic feet at unity or Station 4.		Mean proportion of division.		Area of division in square feet.		Outflow at division during current.
							Cubic feet.
I	39,273	×	0.050	×	518	=	1,017,163
II	39,273	×	0.122	×	187	=	895,968
III	39,273	×	0.214	×	365	=	3,067,591
IV	39,273	×	0.366	×	796	=	11,441,556
V	39,273	×	0.554	×	1,116	=	24,280,894
VI	39,273	×	0.714	×	1,346	=	37,742,774
VII	30,273	×	0.798	×	1,884	=	59,043,972
VIII	39,373	×	0.835	×	2,417	=	79,260,000
IX	39,273	×	0.904	×	2,741	=	97,312,500
X	39,273	×	0.988	×	3,241	=	125,755,491
XI	39,273	×	0.909	×	3,068	=	109,524,242
XII	39,273	×	0 350	×	296	=	4,068,654
Total outflow							553,410,805

[Ebb-current, September 22; range of tide, 3'.95; outflow in cubic foot, per square foot of area at Station 4. = 33,949.]

Number of division.	Outflow in cubic feet at unity or Station 4.		Mean proportion of division.		Area of division in square feet.		Outflow at division during current.
							Cubic feet.
I	33,949	×	0.050	×	518	=	879,286
II	33,949	×	0.122	×	187	=	774,520
III	33,949	×	0.214	×	365	=	2,657,884
IV	33,949	×	0.366	×	796	=	9,890,666
V	33,949	×	0.554	×	1,116	=	20,984,782
VI	33,949	×	0.714	×	1,346	=	32,626,692
VII	33,919	×	0.798	×	1,884	=	51,040,353
VIII	33,949	×	0.835	×	2,417	=	68,516,190
IX	33,949	×	0.904	×	2,741	=	84,121,569
X	33,949	×	0.988	×	3,241	=	108,709,000
XI	33,949	×	0.909	×	3,068	=	94,678,043
XII	33,949	×	0.350	×	296	=	3,517,146
Total outflow							478,396,131

F 27.

SURVEY FOR AN ICE-HARBOR AT THE HEAD OF DELAWARE BAY, NEAR MORRIS LISTON'S OR REEDY ISLAND.

The above-named survey was ordered by river and harbor act of June 14, 1880, in pursuance of reports from this office of January 24 and 28, 1880, printed in Annual Report, Chief of Engineers, 1880, pages 611 to 614.

The field-work was executed in October, 1880, and the chart, of which a tracing is herewith forwarded, was prepared during last winter and spring.

The vicinity of Reedy Island had been examined the year previous.

The study of the most suitable method of construction to be adopted for this harbor is not yet complete, but is in progress and will be made the subject of a special report before the end of the year.

Consultation with those interested in the navigation of the Delaware discloses a predominating weight of opinion in favor of the vicinity of Liston's over Reedy Island, as the proper location for the harbor. The construction will depend partly upon the location, but it may be said that subsequent investigation tends to confirm the conclusions suggested in Colonel Ludlow's report of January 24, 1880, namely: that the structure should be entirely detached from the shore, and be built of iron piles rather than stone piers.

The most advantageous position indicated by the charts seems to be in the vicinity of the intersection of the Finn's Point Ranges with the Port Penn Ranges.

These ranges make such an angle with each other as to compel vessels to haul nearly 5 points to the eastward to pass from one course to the other, the channel cutting off the intersection. Sailing vessels in winter can generally get as far as Liston's even with a northeast wind, and are frequently unable to get further, both by reason of the change of course and the masses of drifting ice encountered near the head of the bay.

Placing the ice-harbor outside and to the westward of the ranges avoids any possible interference with vessels pursuing their voyages, while it would be perfectly accessible to such as may require its protection, whether on the outward or inward passage.

The preliminary estimates given in the report before alluded to were $158,000. It seems probable that the completed structure will require a total expenditure of about $250,000.

The necessity of this harbor to the navigation of the Delaware, particularly during the winter season and from three to five months of the year, has been urgently pressed upon the attention of this office by the various commercial interests.

It is hazardous even for an iron steamer to anchor when exposed to the pressure of moving ice, and there is no doubt that the construction of suitable ice-harbors, and in especial one near the head of the bay, is, next to the permanent deepening of the navigation, and even taking precedence of this in winter, the most valuable improvement needed for the commerce of the Delaware River.

A preliminary appropriation of $100,000 is recommended for this purpose.

APPENDIX G.

IMPROVEMENT OF HARBORS AND RIVERS ON EASTERN SHORE OF CHESAPEAKE BAY; AND OF THE SUSQUEHANNA, BUSH, AND PATAPSCO RIVERS IN MARYLAND, ON THE WESTERN SHORE; OF BROAD CREEK, DELAWARE; OF JAMES AND APPOMATTOX RIVERS AND ONANCOCK HARBOR, VIRGINIA; OF GREAT KANAWHA, ELK, AND SHENANDOAH RIVERS, WEST VIRGINIA; OF NEW RIVER, VIRGINIA AND WEST VIRGINIA; AND OF CAPE FEAR RIVER, NORTH CAROLINA.

REPORT OF LIEUTENANT-COLONEL WILLIAM P. CRAIGHILL, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1881, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., July 27, 1881.

GENERAL: I have the honor to forward herewith the annual report for the year ending June 30, 1881, for works of improvement of rivers and harbors and of surveys which have been in my charge.

Very respectfully, your obedient servant,

WM. P. CRAIGHILL,
Lieutenant Colonel of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

G I.

IMPROVEMENT OF THE CHANNEL OF THE SUSQUEHANNA RIVER ABOVE AND BELOW HAVRE DE GRACE, AND TO COMPLETE THE WORK AT THE FISHING BATTERY LIGHT STATION, NEAR SPESUTIE ISLAND.

The first operations of the United States for the improvement of the navigation of this portion of the river were in 1858, as detailed in the Annual Report of the Chief of Engineers for 1880, beginning at page 615, and the history of the work was there brought down to June 30, 1880. Prior to that date very little had been done since 1871.

An appropriation of $28,000 was made June 14, 1880, in pursuance of the following estimate of January 17, 1880:

Dredging a channel for navigable use to a depth of 12 feet at mean low-water, between Havre de Grace and Spesutie Island	$12,000
Dredging and other work for Fish Commission at or near Battery light	15,000
Removal of cribs, &c., above Havre de Grace	1,000

Proposals for work under the first of these items were invited by advertisement of July 28, 1880. In the specifications it was stated the depth of dredging would average from 3 to 4 feet, in order to attain the required depth of channel of 12 feet at mean low-water. The material to be removed was found to be one-third stiff clay and the remainder sand and alluvium. The material excavated was to be dumped in water from 5 to 11 feet in depth, in places to be provided by the contractor, and to be approved by the United States engineer, without expense to the United States. Care was taken as usual to select places where the material thus dumped would not be a new obstruction to navigation and would not be brought back into the channel again under the influence of the fluvial and tidal currents.

The contract was awarded to the Morris & Cumings Company of New York, at 14⅝ cents per cubic yard for material excavated and redeposited.

They commenced work September 24, 1880, and continued until December 1, when a suspension was caused by the ice. They resumed March 16, 1881, and completed their engagement April 12, 1881. The material removed under the contract amounted to 81,576 cubic yards. The result of the dredging was to restore a navigable channel of 12 feet at mean low-water, with a width of not less than 90 feet except where the depth before dredging was 11 or 11½ feet, and at such places the width excavated was only 45 feet.

Early in December, 1880, a number of the old "boom cribs" above the railroad bridge at Havre de Grace were removed by the use of dynamite very promptly and successfully by Mr. C. L. Kalmbach, the efficient superintendent of such explosives on the James River, who was brought to the Susquehanna for temporary duty. The cost of the work was less than $1,000. An extract from Mr. Kalmbach's report of December 6, 1880, follows:

> I commenced work at noon of November 30, 1880, at the uppermost pier in the channel. The ice was 4 to 5 inches thick, and enabled us to get along more rapidly than we could in open water. At noon of December 4 the ammunition gave out, but we had wrecked sixteen piers and broken a protruding corner of the seventeenth, the outermost of the three next the canal. The cribs in the channel are entirely gone and those in shallow water have their frames thoroughly broken up. Of the 133 torpedoes fired, fully one-fourth were used to blow the sand and mud away from the sides of the cribs so as to enable the wrecking charges to be placed close under the bottoms. The depth of water attained around them was 8 to 12 feet.
>
> Some of the bracing timbers on the inside are still in position, held down by the weight of the stone filling, but the outside frames of all the cribs are entirely gone. It is not likely anything will remain of cribs or filling after the ice goes in the spring.

The cribs removed were of timbers from 12 to 16 inches square, well tied together, bolted and filled with stone. The horizontal dimensions were about 15 by 20 feet, the depth varying from 8 to 18 feet. They were built on the mud, having planked bottoms. Some had sunk in the mud (the heaviest) as much as 8 feet. It was not expected to remove all of them completely. The object was to give such a depth over them that ice would pass readily over them and not hang.

In February, 1881, an ice gorge formed near Havre de Grace, of which the following account is given from observations made by Mr. W. J. McCullough:

> The ice commenced breaking up in the night of 11th and 12th and the first gorge was formed at Rock Run, at upper end of town of Port Deposit, extending across to Spenser's Island, on the western bank; this was at about 5 a. m. on the 12th. Breaking off along western end of gorge, the ice then passed down the western side of the river 1 mile, to Carr's Battery, then in a straight line to head of Watson's Island. along the flats on the western side of the river, piling up on the flats from 4 to 15 feet above low-water and from 6 to 20 feet high about the island. Thence forcing its way around north end of island, it passed down the eastern side of river and island until it met the solid ice above railroad bridge, when it gorged near Verdin's wharf and

> end of island, the ice piling back to head of island. This mass of ice, it may be well to note, did not *break* away at all, but has simply melted and disappeared in large part.
>
> When this last gorge had formed on *eastern* side and at *foot* of Watson's Island, the other gorge on *western* side, at *head* of island, broke away at about 12 noon on Saturday, 12th, stopping only for a few minutes at lower end of island and outlet locks of canal, which latter is covered to a depth of 15 or 20 feet.
>
> It may be noted that the gorge at *head* of island, did not form on line of old boom piers, but on shoal in the river. A careful examination discovered no traces of these piers except the two near canal bank, which were not blown up last year. After passing lower end of Watson's Island and canal locks as above, the ice passed through bridge piers and down the "main" or western channel until it encountered the heavy solid ice extending *up* from Spesutie Island to near Donoho's Battery light, when it formed a gorge *above* the Battery, extending across the channel and over on to the flats on either side. This gorge backed the ice in heavy masses up stream to a line joining the head of the Penny shoals and the Furnace wharf, above Point Concord light, the ice extending from the bottom up to 4 or 5 feet above low-water. Deflected by this dam near Point Concord, the still down-flowing ice and water forced a passage over the flats, in a southeasterly course, toward Turkey Point (at mouth of Elk River) and so passed out to the bay.
>
> On the 22d and 23d, when examination was made, the ice *above* railroad bridge was still piled up from 5 to 15 feet high on the flats along western bank of river, as high up as Lapidum, and on the east bank from Port Deposit to a quarter mile above railroad bridge from 4 to 10 feet high. For a mile below the bridge the western channel is open and a narrow opening permits small vessels to get out by the old channel close under western shore, but the main channel is still filled with ice.

Much ice remained above and below Havre de Grace as late as the 1st of March, 1881.

Operations were commenced at the Fishing Station at Donoho's Battery light in July, 1880. The work desired by the Fish Commissioner was the removal of the old riprap wall around the light-house, the inclosing of the whole area of the site with a new wall, using the material of the old; the dredging of a large part of the inclosed area to a depth of 7 feet at mean low-water; filling in a portion of the site above high-water mark to receive sheds, &c.; dredging a channel to connect the inclosed area with the main channel of the river; the building of a crib outside the basin, intended for a mooring wharf; the putting up of a crane to aid in handling fish, ice, &c.; and the construction of a platform outside the basin, upon which to draw up the seines. All this has been essentially completed except the last item. It is believed the expenditure of $2,000 in the year beginning July 1, 1881, will complete the fishing station to the satisfaction of the Commissioner.

The appropriation of $15,000 of March 3, 1881, was for the river above and below Havre de Grace. No part of it was spent above Havre de Grace prior to July 1, 1881. An examination made in May, 1881, indicated the necessity for the removal of 75,000 cubic yards of material between Havre de Grace and Port Deposit, to make a channel 12 feet deep at mean low-water and 50 feet wide.

Some additional dredging may also be needed to give greater width to the channel below Havre de Grace. To determine the extent of this a resurvey is needed, which will be soon made, and thereafter a special report.

Money statement.

July 1, 1880, amount available	$28,000 00	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$43,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		35,878 31
July 1, 1881, amount available		7,121 69

Abstract of proposals for dredging Susquehanna River, Maryland, opened at 12 *o'clock m. August* 18, 1880.

No.	Name.	Residence.	Time of completion.	Price per cubic yard.	Remarks.
1	F. Pidgeon, jr	New York	Provided in specifications.	$0 15¼	Measured in scows.
2	F. B. Colton	Wilmington, Del		15	Do.
3	E. Brainard, jr	New York		18	
4	American Dredging Company.	Philadelphia		18	
5	Morris & Cumings Dredging Company.	New York		14⅝	
6	H. P. Gilbert	Georgetown, D. C		18	Measured in scows.

Contract with Morris & Cumings Dredging Company.

G 2.

IMPROVEMENT OF NORTHEAST RIVER, MARYLAND.

Upon a report and an estimate from the Engineer Department, an appropriation of $10,000 was made for this river in June, 1872, which was expended in carrying out the project estimated for; namely, making a channel 60 feet wide at bottom, with a ruling depth of 5 feet at mean low-water, from the 5-foot curve near the mouth of the river to the wharf at Northeast, and making a turning basin in front of the wharf about 120 feet square. Originally there were shoals below the town with less than 2 feet of water on them at low-water.

This work was done by contract in 1872 and 1873. Nothing further was done for this place until 1879, when Congress directed a resurvey, which was made in October, 1879. It was found that while the dredged channel had stood quite well, somewhat greater depth was desired by the community.

Congress made an appropriation of $5,500 June 14, 1880. A contract was entered into with Mr. Van Patten, at the rate of 24 cents per cubic yard for dredging and redepositing, scow measurement. The work began September 16, 1880, and continued through October and November, when a suspension was caused by ice. The work was renewed March 15, 1881, and completed at the close of April.

It is only about 5 miles from the town of Northeast to the mouth of the river of the same name. The result of the contract of 1880–'81 has been a channel with not less than from 5½ to 6 feet at mean low-water. An enlarged turning basin has been excavated near the town, to which a depth of 8 feet was given. Where a small stream comes into the river just below the wharves, and brings down much sand and mud, the depth, for 200 feet in length, has been made 10 feet.

The quantity of material removed has amounted to 19,876 cubic yards, measured in the scows.

The dredged material was deposited in coves on either side of the river, at as great a distance as possible from the channel, so as to avoid any danger of its being washed back again.

Northeast is a thriving town, with a population of about 1,200. It does a large business in merchandise, and contains a number of manufacturing establishments of various kinds. A large amount of grain is shipped from the town, and a good business is done in railroad ties, spokes, staves, &c. Two vessels, respectively of 120 and 90 tons, trade regularly to Northeast, and others make occasional trips. At long intervals a steamboat is seen at the wharves.

The location of the town on the railroad to Baltimore and Philadelphia makes that the chief route of the trade, and keeps down the commerce on the river.

Money statement.

July 1, 1881, amount available	$5,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	5,499 62
Amount available	38

Abstract of proposals for dredging Northeast River, Maryland, opened at 12 m., August 17, 1880.

No.	Name.	Residence.	Time.		Price per cubic yard.	Remarks.
			Commence.	Complete.		
1	F. Pidgeon, jr	New York	Within fiscal year.	Within fiscal year.	$0 55	Scow measurement.
2	J. Van Patten	Philadelphia	Nov. 15, 1880.	Apr. 10, 1881.	24	Do.
3	American Dredging Company	do	Oct. 1, 1880	Jan. 1, 1881	30	Do.
4	Daniel Constantine.	Baltimore	Apr. 1, 1881	June 31, 1881	35	Do.
5	H. P. Gilbert	Georgetown, D. C.	Oct. 1, 1880	....	33	Do.

Contract with J. Van Patten.

INFORMATION AS TO THE COMMERCE OF NORTHEAST RIVER, FROM MR. W. W. DAVIS, RECEIVED THROUGH HON. J. L. THOMAS, COLLECTOR OF BALTIMORE.

There are shipped from this place (Northeast), to southern markets principally, 30,000 bushels grain; received, 3,000 bushels of coal; shipped and received, from 2,000,000 to 3,000,000 feet of oak and pine lumber; shipped, from 2,000 to 3,000 tons of hay; kaoline and other clays, from 2,000 to 3,000 tons; merchandise, from 2,000 to 3,000 tons. Vessels drawing about 8 feet of water, loaded, would be all that are needed in our waters. No steamers run up here at this time, except for excursions. The tonnage to suit the trade would be vessels carrying from 10 to 150 tons. The class of vessels running here at present are scows and light-draught schooners.

I am satisfied that the cleaning of the part of the channel has done an immense amount of good to our shipping interest, and all feel thankful to Congress for the generous act in opening our harbor once more.

There are at this point large deposits of clays that must, and are, finding their way to other markets. As the clay-beds of New Jersey are fast being worked out ours have just began to draw attention from the other States. Our kaoline is as good as any yet found in this country, and the value of it is $11 per ton, delivered in Philadelphia or Baltimore. This section can produce millions of tons of this staple.

As all the section north of our town contains large mines of this valuable product, so also on the south lie near the surface millions of tons of other clays. All will be valuable in a short time, and must find their way to distant markets.

G 3.

IMPROVEMENT OF ELK RIVER, MARYLAND.

Previous to June 30, 1880, the last work done on this river was finished in February, 1876. Up to that time a dike had been built 900 feet long, on the right side of the stream, beginning at a point 1,100 feet below the bridge at the town.

A channel had also been dredged, 40 feet wide at bottom and 6 feet deep at low-water, from the town to a point about half a mile below. A basin had also been excavated near the town to enable steamers to turn in.

An examination in July, 1880, showed a shoaling in the basin and dredged channel from the bridge to the head of the dike, to an average depth of 5 feet at mean low-water, and an available depth of only 4½ feet. On the remaining 1,800 feet of the old cut there was still a 6-foot depth at low-water. The worst shoaling was near the turning basin, a short distance below the bridge.

Advertisement was made in July for proposals for the expenditure of the appropriation of $10,000 of June 14.

The material to be removed consisted of mud, compact clay, and sand, in various proportions and mixtures.

The proposed depth of cutting to attain a channel depth of 7 feet at mean low-water varied from 6 inches to 5 feet. The rise of tide is about 2¼ feet. The specifications called for the excavation of a channel 50 feet wide (or of such width as the price of dredging and the extent of the appropriation would allow), from the bridge at Elkton to the confluence with Little Elk, and an area near the bridge for turning steamboats. The material was required to be deposited on or near the banks of the river, in places to be procured by the contractor, without expense to the United States, subject to the approval of the United States engineer. This approval was given only on condition that the redeposited material should not form an obstruction to navigation, be in danger of getting back into the channel, or be an injury to riparian owners.

The first bids received were necessarily rejected on account of too high prices. A contract was at last made with Mr. G. H. Ferris, on the basis of 24 cents per cubic yard for material measured in scows, and 30 cents in place. Much delay has ensued in the progress of the work, partly due to the severity of the winter, but mainly to the difficulty in getting rid of the dredged material. Up to the end of June, 1881, an excavation, beginning 1 mile below the bridge, had been made up stream for a distance of 1,660 feet, to a width of 60 feet, and a depth of 7 feet at mean low-water, and a cut of 40 feet wide and 8 feet depth had been carried still farther, to a point 4,300 feet from the beginning. The number of cubic yards removed under the contract, still incomplete at that date, was 22,557. Of the material excavated in June, 5,117 yards were deposited in scows, towed down the river and dumped in the cove between Henderson's and Little Welch's Points, about 5½ miles from the lower end of the work. The balance, 1,567 yards, was deposited on deck-scows and wheeled off back of the old dike.

A new appropriation of $5,000 was granted March 3, 1881.

Proposals were soon thereafter called for, the specifications for the additional work being similar to those of the contract still pending, except that the depth of the excavation was increased to be 8 feet at mean low-water, and was extended to include the removal of a bar, between Little Elk and the Club House, about 1,000 feet long. The contract was awarded to the same contractor, the price being greater than before, namely, 33⅓ cents per cubic yard, measured in the scows.

When the existing contracts are finished, which will exhaust the available funds, there will be needed the removal of about 35,000 cubic yards of material to complete the adopted project, namely, in excavating a channel 75 feet wide and 8 feet deep at mean low-water up to the town of Elkton, with a turning-basin at the wharves. This, at the last contract price, would cost $12,000.

The dike below the town is also very dilapidated and requires renewal or extensive repairs, which will cost $1,500. An old crib or hulk near the channel at Frenchtown is dangerous to navigation and should be removed. The cost need not exceed $100.

Money statement.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$15,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,632 65	
July 1, 1881, outstanding liabilities	181 84	
		4,814 49
July 1, 1881, amount available		10,185 51
Amount (estimated) required for completion of existing project		13,600 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		13,600 00

Abstract of proposals for dredging Elk River, Maryland, opened at 12.30 *o'clock p. m., August* 17, 1880.

No.	Name.	Residence.	Time.		Price per cubic yard.	Remarks.
			Commence.	Complete.		
1	F. Pidgeon, jr.	New York	Oct. 15, 1880.	Within fiscal year.	$0.39⅝ 50	Scow measurement. Measured in place.
2	H. P. Gilbert	Georgetown, D. C.			37	Not measured in place.
3	Daniel Constantine,	Baltimore	April 1, 1881	June 30, 1881.	37	Measured in scows.
4	American Dredging Company.	Philadelphia	Nov. 1, 1880.	Mch. 31, 1881.	35 45	Measured in scows. Measured in place.
5	J. Van Patten	do	Nov. 15, 1880.	May 10, 1881.	31 35	Measured in place and placed on shore. Measured from scows and wheeled from scows.

All bids rejected.

The above work was contracted for October 18, 1880, under authority from Chief of Engineers, by Mr. G. H. Ferris, at 30 cents per cubic yard, measured in place, or 24 cents measured in scows or embankment.

Abstract of proposals for dredging Elk River, Maryland, opened at 12.30 *o'clock p. m., June* 15, 1881.

No.	Name.	Residence.	Time.		Price per cubic yard.	Remarks.
			Commence.	Complete.		
1	G. H. Ferris	Baltimore	Aug. 1, 1881.	Jan. 1, 1882.	$0 33⅓	Measured in scows.

Contract with G. H. Ferris.

INFORMATION AS TO THE COMMERCE OF ELK RIVER, FROM MR. JOHN E. WILSON, RECEIVED THROUGH HON. J. L. THOMAS, COLLECTOR OF BALTIMORE.

There are received at this place (Elkton) about 3,000 tons of fertilizer, 10,000 tons coal, 50,000 bushels grain, and 2,000 cords of wood, yearly, to which should be added about 10,000 tons coal for the use of the mills above, which are landed lower down, owing to the want of water of sufficient depth at this time.

One schooner of 50 tons and one sloop of 35 tons make regular trips to and from Baltimore City. Coal is brought up in barges of from 130 to 150 tons capacity.

There is every prospect of a steamer to run between Baltimore and Elkton.

Since the deepening of the channel the county authorities have determined to make a draw in the bridge at this port, which will give increased wharf facilities of about 400 feet; the money for the same has been levied.

A grain elevator, 20,000 bushels, is now under contract for building.

All of these improvements were useless until the river was deepened and floating facilities offered.

We have five large general stores, five smith-shops, two large flour-mills, three machine-shops, and 6 provision stores; one large rolling-mill, 2 miles above town, to which coal and iron are hauled from Wilson's wharf; two paper-mills, 3 miles above, and one cloth manufactory, all of which haul from the wharf.

A large amount of lime and shells are received here by boats, for the use of farmers.

G 4.

IMPROVEMENT OF CHESTER RIVER, FROM SPRY'S LANDING TO CRUMPTON, MARYLAND.

The following special report on this portion of Chester River was made in November, 1880:

EXAMINATION AND SURVEY OF CHESTER RIVER, MARYLAND.

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., November 23, 1880.

GENERAL: Among the localities of which a survey or examination was directed by the law of June 14, 1880, was Chester River, Maryland, between Kirby's Landing and Spry's Landing. The survey was made in October, 1880, by Mr. Henry Bacon, with his usual care and accuracy. A copy of his report, dated November 18, 1880, is forwarded herewith. The map will be furnished in a few days.

The portion of the river covered by the survey is about 5¼ miles in length, and is between the counties of Kent and Queen Anne.

Seven feet water can now be carried at all stages of the tide to Spry's Landing, which is 7 miles above Chestertown. From Spry's to Crumpton, 2 miles farther, 6½ feet can be carried only at or near high-water. The bridge at Crumpton is somewhat of an obstruction to navigation, the width of the draw being but 37½ feet. Above Crumpton the channel becomes narrow and shoal. The range of the tide at that point is about 2 feet.

It is proposed to improve by dredging and placing the excavated matter near the sides of the cut, where it will not find its way back again, but will form banks, the effect of which will be to force more of the water in the river into the dredged channel.

The estimate submitted is in two parts—referring to the portions of the river respectively from Spry's and Kirby's to the bridge at Crumpton. Below the bridge there are alternative estimates for channels 100 feet wide and 120 feet wide, and each 8 feet deep at mean low-water, respectively, $11,000 and $13,000. There are also alternative estimates for channels above Crumpton, but only 50 and 65 feet in width and 6 feet depth at mean low-water, $7,000 and $9,000, respectively.

Very respectfully, your obedient servant,

WM. P. CRAIGHILL,
Major of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. HENRY BACON, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., November 18, 1880.

COLONEL: I have the honor to submit the following report of the survey and examination of Chester River, Maryland, from Spry's Landing to Kirby's Landing, a distance of about 5¼ miles by the channel of the river. Spry's Landing is about 7 miles above Chestertown and 2 miles below Crumpton. Crumpton is practically the head of navigation for steamboats and for vessels drawing more than 4 feet of water. Seven feet depth can be carried at all stages of the tide to Spry's Landing, and at least 8 feet at mean low-water. Between Spry's and Crumpton, 6½ feet can be carried only at or near the time of high-water.

The tides vary with the force and direction of the winds. The water often falls fully 1 foot below mean low-water, and does not rise much above it during 24 hours or more. It occasionally falls 2 feet below mean low-water. Reliable navigation, therefore, requires 1 foot extra depth below mean low-water.

The portion of the river surveyed is divided into two parts by the draw-bridge at Crumpton, which is about 2 miles above Spry's Landing, and 3½ miles below Kirby's Landing. The draw passage has but 37½ feet available width. This is insufficient for the passage of steamboats. The channel above the draw soon becomes narrow and shoal, though capable of improvement. If appropriation be made for the improvement above the draw, it might not be advisable to expend it till the draw passage be widened. The estimates for improvement are therefore made separately from Spry's Landing to Crumpton, and from Crumpton to Kirby's Landing.

Below Crumpton they are made for 8 feet depth at mean low-water, and for widths of 120 and 100 feet. The dredging for this depth will extend over comparatively small distances on this part of the river; on the greater lengths, where no dredging is required, the 8-foot channel is much wider than that proposed for excavation.

From Crumpton to Kirby's Landing the estimates are made for 6 feet depth at mean low-water, and for the widths of 65 and 50 feet.

The river separates the counties of Kent and Queen Anne, both of which are naturally rich and fruitful, producing large amounts of grain and fruit for transportation, and capable of further large development.

The annexed letter of Messrs. Harrison & Bro., who are reliable merchants at Crumpton, gives some idea of the present extent of the river transportation. The map herewith presented is on the scale of 300 feet to an inch. It shows more than 2,800 located soundings, besides a large number approximately located. The work of the survey and map has been done with care and precision.

Tidal observations were made during the time of the survey, from October 8 to October 29, 1880, from which mean low-water was determined to be 1.9 feet of the gauge. The level of the gauge is preserved on the west pile of the south trestle of the bridge at Crumpton, by 4, 5, and 6 nails, driven at the level of 4, 5, and 6 feet of the gauge. The mean range of the tide as observed was 2.1 feet. The river and flats are wide on most of the portion surveyed. The shoals are in the wide places, as might be expected. They consist of compact sand. The bed of the river and flats are elsewhere of very soft mud. There is some rock bottom in the upper narrow portion of the river, but it is below the depth proposed for dredging. Such a disposition can be made of the dredged material as will conduce to the preservation and permanence of the dredged channel, by depositing it at a proper distance and on the sides, to serve as training-walls to assist in concentrating the main currents into the channel. In the narrow portions of the river, towards Kirby's Landing, the materials can be deposited on the adjacent marsh banks. The method suggested is the same as is successfully practiced on the Wicomico and Elk rivers, in Maryland, where the material is deposited in an elevated chute and washed down the inclination by the force of water pumped upon it.

The estimates are made for the material measured in excavation, a proper allowance being made for extra depth of slopes.

The whole work can be done most advantageously within one year's time.

ESTIMATES.

From Spry's Landing to Crumpton.

For a channel of 120 feet width and 8 feet depth at mean low-water:

39,900 cubic yards excavation, at 30 cents	$11,970
Add 10 per cent. for expenses, superintendence, &c	1,197
Total	13,167

For a channel 100 feet in width and 8 feet depth at mean low-water:

32,500 cubic yards excavation, at 30 cents	9,750
Add 10 per cent. for expenses, superintendence, &c	975
Total	10,725

From Crumpton to Kirby's Landing.

For a channel 65 feet in width and 6 feet depth at mean low-water:

28,000 cubic yards excavation, at 30 cents	$8,400
Add 10 per cent. for expenses, superintendence, &c	840
Total	9,240

For a channel 50 feet in width and 6 feet depth at mean low-water:

20,800 cubic yards excavation, at 30 cents	$6,240
Add 10 per cent. for expenses, superintendence, &c	624
Total	6,864

Respectfully submitted.

HENRY BACON,
Assistant Engineer.

Col. WM. P. CRAIGHILL,
Major of Engineers, U. S. A.

COMMERCIAL STATISTICS.

CRUMPTON, *November* 15, 1880.

DEAR SIR: We have, as you are aware, two lines of passenger and freight steamers running from Baltimore to our town, making an arrival or departure from Crumpton each day in the week.

We have two grain and general freight vessels that ply weekly between here and Baltimore, besides which we have various other steamers and sailing vessels that arrive here at irregular intervals throughout the year, such as peach steamers and excursion steamers during their season of the year, and sailing vessels bringing phosphates, lime, lumber, and carrying out wood, timber, &c. The two vessels we own carry from here annually from 100,000 to 150,000 bushels of corn and wheat, besides wood. We bring back from 500 to 1,000 tons phosphates, 300 to 600 tons coal, 20,000 to 30,000 bushels shells, from 10,000 to 20,000 bushels lime, besides lumber, bricks, merchandise and other freight, the value of which, I suppose, would amount to $100,000 to $200,000. The amount of freight carried from and brought to Crumpton by steamers is considerable, but I can form no idea as to its amount. The country around Crumpton, on both sides of the river, is to a very large extent planted in peach orchards, and very many thousands of boxes and baskets are shipped from here by the river, and many more would be but for the uncertainty of the arrivals and departures of steamers, caused by the obstruction formed by the bar just below us.

By the removal of this obstruction to the navigation of our river, the carrying trade by vessels and steamers in all its branches would be greatly increased and the commercial interests of the town and surrounding country correspondingly promoted. If I can give you any information touching any matters that I have omitted and of which you would like to be informed, I will do so with pleasure.

Very respectfully, yours,

HARRISON & BRO.

Mr. BACON.

An appropriation of $6,500 for this locality was made March 3, 1881. It was recommended to the Chief of Engineers that the money be expended in dredging to a depth of 8 feet at mean low-water and to a width of about 80 feet. Proposals were opened June 15, 1881, and the work awarded to the lowest bidder.

Money statement.

Amount appropriated by act approved March 3, 1881	$6,500 00
July 1, 1881, amount available	6,500 00
Amount (estimated) required for completion of existing project	6,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	6,500 00

Abstract of proposals for dredging in Chester River, Maryland, opened at 1 *o'clock p. m., June* 15, 1881.

No.	Name.	Residence.	Time.		Price per cubic yard.	Remarks.
			Commence.	Complete.		
1	G. H. Ferris	Baltimore	Oct. 15, 1881.	July 1, 1882	$0 38	Measured in scows or buckets.
2	D. Constantine	do		June 30, 1882	27	Measured in place.

Contract with D. Constantine.

INFORMATION AS TO THE COMMERCE OF CHESTER RIVER, RECEIVED FROM HON. J. L. THOMAS, COLLECTOR OF BALTIMORE.

Chester River from Chestertown down, including Queenstown.—Crumpton, on Chester River, is about 33 miles from the mouth of that river, and is a lively trading point. A steamboat runs to the place.

Chestertown is situated on Chester River about 25 miles from its mouth; it has a population of 2,800 inhabitants; the town is largely engaged in trade and business, and is mainly devoted to that purpose; four steamboats ply between it and Baltimore.

There are three fertilizing factories, and one factory for canning fruit and oysters. Among the products of trade were about 500,000 bushels of grain and 500,000 boxes of peaches.

Queenstown is near the mouth of the river; it is a very important site for trade. Because of its location it furnishes an outlet for the trade and products of a large extent of country; quite a thrifty trade is maintained here. It is an important and profitable site for the steamboat lines that regularly ply there. At all of these places a considerable trade is maintained with sailing vessels.

Chester River on the line of these places is an important outlet to a valuable trade; a trade which enters as an element prominently into the trade of the country, locally and nationally.

Besides the grain interests of this section, that of the peach-growing interest is of vast and expanding value.

G 5.

IMPROVEMENT OF CHESTER RIVER AT KENT ISLAND NARROWS, MARYLAND.

This work is comparatively unimportant, but it has a long history which may be found in detail in the annual report for 1879.

In brief, its object may be stated to be to reopen a channel formerly existing between Chester River and Eastern Bay, which had been shut up by a solid causeway, some 60 years ago, under the authority of the State of Maryland.

The first appropriation, of $15,000, was made March 3, 1873; a second, of $5,000, June 23, 1874, and a third, of $5,000, August 14, 1876. With these funds the causeway was broken through and a channel dredged to a width of about 80 feet, partly in Chester River and partly in Eastern Bay; a draw-bridge having been also put up on the site of the causeway by the community interested in the navigation. The depth in the dredged channel was made 7½ feet at mean low-water.

While this channel is used to some extent by sailing vessels, and is supposed to be of some value to traders between Eastern Bay and Baltimore and other points on the northern portion of the Chesapeake, the expectation of its use by the steamers going to and from Easton Point and adjacent landings has not been realized.

Another appropriation of $3,000 was made June 18, 1878, but no further operations have been undertaken towards the completion of the improvement. A resurvey made in April, 1880, indicates some filling in the dredged channel in its exposed parts, which was not unexpected, its use by steamers having been depended on to some extent to keep it open.

It is not considered necessary at present to expend the available balance.

This place is in the collection district of Baltimore.
The nearest light-house is that at Love Point.

Money statement.

July 1, 1880, amount available	$2,581 45
July 1, 1881, amount available	2,581 45

G 6.

IMPROVEMENT OF THE HARBOR OF QUEENSTOWN, MARYLAND.

At the close of the fiscal year ending June 30, 1880, some dredging was being done in the channel connecting this harbor with Chester River, the object being to remove some sedimentary deposits which had been made since the opening of the channel in 1872, and to straighten it by reducing the curvature of the bends. The result was a channel 100 feet wide and 8 feet deep at mean low-water, from Chester River to the inner harbor, which is quite commodious and has by nature a depth of 9 or 10 feet at mean low-water. The work was completed in August, 1880, under a contract with Mr. D. Constantine. The dredging and dumping of the excavated material, which was partly hard sand and partly a tough, light-colored clay, cost 23 cents per cubic yard, measured in scows. The material was dumped in the deep holes in the Chester River, not far from the mouth of Queenstown Creek, but without detriment to the navigable channel of Chester River.

Money statement.

July 1, 1880, amount available	$2,898 56
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	2,898 56

G 7.

IMPROVEMENT OF THE PATAPSCO RIVER, BALTIMORE, MARYLAND.

At the close of the last annual report the only work in progress was the widening of the upper end of the Fort McHenry division of the channel. This was begun in May, 1880, and completed in October, 1880, The contractors removed 181,930 cubic yards of material, at a cost of 18.7 cents per cubic yard. Some of the material near Fort McHenry was harder and tougher than in the channel below. It was described in the specifications as one-third stiff clay and two-thirds sand and alluvium. The contract required 65,000 cubic yards to be deposited on the space in front of the Fort McHenry seawall and on the flats behind the site, which are inside the bulkhead lines of the harbor and are to be brought up above the level of high-water. The remainder of the material was taken down the river and deposited in coves where it will not return to the channel.

The following special report was made in January, 1881.

IMPROVEMENT OF CHANNEL OF APPROACH TO THE HARBOR OF BALTIMORE, MARYLAND, IN PATAPSCO RIVER AND CHESAPEAKE BAY.

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., January 5, 1881.

GENERAL: Just before the adjournment of Congress last June, I reported by telegraph, on a call for information from the Senate, that it would probably cost $1,500,000 to deepen to 27 feet, at mean low-water, the channel of approach to the harbor of Baltimore, in Chesapeake Bay and the Patapsco River. This estimate was an approximate one, and founded on the best information attainable at the moment of the sudden call.

An accurate and very careful survey of the whole line of the channel has been made, and I am now able to report reliably on the subject, A tracing is inclosed, showing the line of the channel as at present in use, with a proposed cut-off near the lower end of the Brewerton Channel, which will be referred to more particularly in another part of this communication.

Further information as to local features may be obtained from the Coast Survey chart mentioned on this tracing, which may be placed over it for comparison.

The "Brewerton" Channel, as originally projected by the engineer officer of that name, extended several miles farther (in the same straight line) towards the eastern shore of the bay. The current of the Susquehanna River swept almost directly across that portion of the Brewerton Channel which is to the eastward of the line drawn tangent to the western bank of that river, marked in the tracing by the letters *a*, *b*. This current caused a heavy and unceasing deposition in the portion of the Brewerton Channel to the eastward of the point *a*.

This difficulty had much to do with the search for a better position for the channel, and led in part to the adoption of what is now called the "Craighill" Channel, and the abandonment of the old ship channel passing near Swan Point.

These changes in the position of the channels have proved highly advantageous to the navigation and commerce connected with the city of Baltimore.

It is, however, found necessary to keep the dredges at work very much in the portion of the Brewerton Channel still used, to the eastward of the point *a*.

When the changes referred to were made, the depth of channel sought to be attained was 22 feet at mean low-water. Under the pressure for the accommodation of vessels of deeper draught, the depth was increased to 24 feet at mean low-water, which was gained in 1874, and has since been maintained. It should be mentioned to the credit of the city of Baltimore that she spent her money freely for this improvement in co-operation with the United States Government.

The needs of her commerce now cause Baltimore to wish for a still greater depth of channel, viz, 27 feet at mean low-water. The occasion is deemed a favorable one for making still further changes in the position of the channel, the main features of which changes would be the abandonment of another portion of the Brewerton Channel, as well as the upper part of the Craighill Channel, and the adoption of a line marked on the tracing as the "proposed cut-off." The advantages of these changes would be the shortening of the total length of the channel by nearly a mile, and the getting rid of a part of the Brewerton Channel—difficult and expensive to keep open.

It should be mentioned that the proposed cut-off is in the direction of a natural channel, of no great depth, called the "Swash." Some of the material in it is harder than any found in the Brewerton Channel, and the probabilities are that this channel would have been much deeper under natural agencies if the material had been sufficiently soft to enable the existing currents to move it away.

Consideration of the same probabilities, as well as experience here and elsewhere, lead to the opinion that if the channel were once made in this proposed position to the depth of 27 feet, it could be more easily and cheaply maintained than in the portion now used.

The cost of the deepening of the channel to 27 feet at mean low-water, from estimates based on the survey just completed, is found to be $1,250,000, or less by $250,000 than the approximate estimate of last June.

If this important improvement be undertaken, the necessary funds should be liberally provided, as great economy would result from its completion in the shortest possible time. All the advantages of the improvement can only be had when it is completed. The longer the time given to the work, the longer will Baltimore be kept waiting for what her commerce needs at once. The longer the time given to the work, the longer will the existing commerce be vexed by the presence of many dredges working in the channel, for while these machines are deepening the channel they must be in it, and more or less in the way of passing vessels.

At this time there is much discussion as to the choice of a route for the ship-canal proposed to connect the Chesapeake and Delaware Bays. From present appearances it would seem that the choice is to be between the most northern and the most southern routes, viz, the Sassafras route and the Choptank route. As this canal is, in one of its aspects, but the continuation of Baltimore's channel to the ocean, the changes proposed above have an important bearing on the choice of a route for the canal.

If the Sassafras route be adopted, the opening of the proposed cut-off would increase the distance from Baltimore to the mouth of the Sassafras River, or it would be expedient not to make the cut-off, but to adhere to the Brewerton Channel as now used. In addition to the maintenance of the portion of the Brewerton Channel which it is now proposed to abandon for reasons stated above, and which seem to be good, it would be also necessary to reopen the portion of the Brewerton Channel abandoned years ago, and maintain it for all time to come. The probabilities are against the practicability of maintaining this old portion of the channel with the increased depth, except at very great expense.

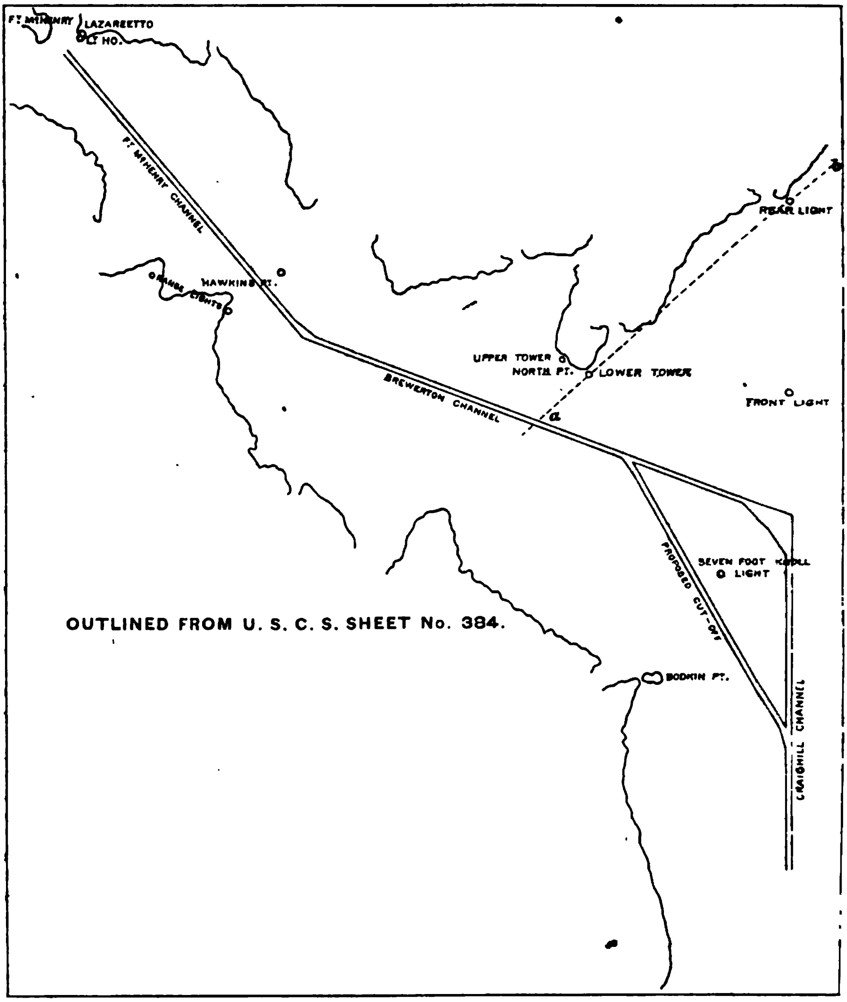
On the other hand, if the Choptank route be adopted, all the advantages of the proposed cut-off are in favor of that route. The natural route to the ocean from the mouth of the Patapsco is through the proposed cut-off and towards the western mouth of the Choptank route. In such matters, unless there be strong reasons to the contrary, it is best to follow the indications of nature.

Thanks are due to Mr. J. L. Seager, assistant engineer, for his earnest and faithful labor, under much exposure, and in the face of serious obstacles, in the conduct of the survey upon which the estimate now submitted is based.

Very respectfully, your obedient servant,

Wm. P. Craighill,
Lieutenant Colonel of Engineers.

Brig. Gen. H. G. Wright,
Chief of Engineers, U. S. A.



OUTLINED FROM U. S. C. S. SHEET No. 384.

Congress sanctioned this proposed increase of depth and appropriated $150,000 for beginning the work. A contract has been made for dredging the "cut-off" shown on the sketch above. The contractors are the American Dredging Company of Philadelphia. The price for excavation and redeposit is 10¾ cents per cubic yard. Borings made in the line of the proposed "cut-off" indicate that where depths of 16 feet or less exist, the excavations will be through fine sand and shells, and in greater depths through soft mud and sand. The material is to be dumped, in water from 5 to 11 feet in depth, in the bay, at least 1 mile eastward of the Craighill Channel, and not less than 1 mile south of the Brewerton channel range. The work under this contract is to be commenced in July, 1881, and completed in 1882.

Quite extensive repairs to the machinery and house of the United States tug Leslie having become necessary, they were taken in hand in January, 1881, and completed in May.

Money statement.

July 1, 1880, amount available	$218,975 41	
Amount appropriated by act approved March 3, 1881	150,000 00	
		$368,975 41
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		46,258 31
July 1, 1881, amount available		322,717 10
Amount (estimated) required for completion of existing project		900,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		900,000 00

LIEUTENANT-COLONEL WM. P. CRAIGHILL, CORPS OF ENGINEERS, TO THE GOVERNOR OF MARYLAND.

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., January 17, 1881.

SIR: I have the honor to inclose for the consideration of your excellency a copy of the law relative to injuries done to the channel leading to this city, which has been deepened at great expense by the joint efforts of the United States, the State of Maryland, and the city of Baltimore.

I am informed that this law, approved April 4, 1870, is very frequently violated to the serious detriment of the channel.

I suppose this is a proper subject for your intervention through the agency of the oyster police force of the State. I by no means wish to charge that force with neglect, as I know the field of their operations is extensive and their numbers small.

Very respectfully, your obedient servant,

WM. P. CRAIGHILL,
United States Engineer in charge.

Hon. W. T. HAMILTON,
Governor of Maryland.

CHAPTER 405. AN ACT to protect the "Craighill Channel" at the mouth of the Patapsco River.

SECTION 1. *Be it enacted by the General Assembly of Maryland,* That it shall not be lawful for any person or persons to rake, drag, or dredge for oysters within 500 yards of either edge of the new channel at the mouth of the Patapsco River, known as the "Craighill Channel," extending from the Seven-Foot Knoll to the mouth of Magothy River.

SEC. 2. *And be it enacted,* That any person or persons violating the first section of this act shall forfeit his boat or vessel, and it shall be lawful for any justice of the peace of the county or city in which such person or persons shall be arrested, to try such person or persons, and on conviction to condemn said boat or vessel, and sell the same on five days' notice and fine the said offender or offenders a sum not less than $5, or more than $25, for each and every offense, and the said justice of the peace shall pay over one-half of said fines and forfeitures to the informer and the other half to the school board of said county or city.

SEC. 3. *And be it enacted,* That this act shall take effect from the date of its passage.

Approved April 4, 1870.

SECRETARY OF THE BOARD OF PUBLIC WORKS TO LIEUTENANT-COLONEL WM. P. CRAIGHILL, CORPS OF ENGINEERS.

ANNAPOLIS, *February* 4, 1881.

DEAR SIR: I have the honor to inform you, that at a meeting of the Board of Public Works held this day in the city of Annapolis, a communication from you was presented and read, and I was directed to inform you that the Board has called the attention of the commander of the police force to the matter set forth therein, and directed him to give it his especial notice.

Respectfully, yours,

RICHARD H. GREEN,
Secretary.

Lieutenant-Colonel CRAIGHILL.

Abstract of proposals for dredging channel leading to harbor at Baltimore, Md., opened at 12.5 p. m., April 7, 1881.

No.	Name.	Residence.	Quantity bid for.	Price per cubic yard.	Remarks.
			Cub. yards.		
1	F. B. Colton	Washington, D. C	1,000,000	$0 21	Equal quantities of hard and soft material.
2	Morris & Cumings Dredging Company.	New York City	2,250,000	19	
3	George C. Fobes & Co	Baltimore	1,000,000	19¾	Half soft and half hard material.
4	American Dredging Company.	Philadelphia	2,250,000	10¾	Complete December 31, 1882.

Contract with American Dredging Company.

COMMERCIAL STATISTICS.

CUSTOM-HOUSE, BALTIMORE, MD.,
Collector's Office, July 19, 1881.

SIR: Agreeably to your written request of 25th May last, you are herewith furnished with statistics relating to the commerce of Baltimore for the fiscal year ending June 30, 1881.

CHIEF IMPORTS, FREE.

	Invoice value.
Coffee, 58,650,548 pounds	$6,787,382 00
Guano, 3,197 tons	70,985 00
Hides	202,089 00
Nitrate of soda	218,712 00
Sulphur	430,917 00
Miscellaneous	1,146,735 00
	8,856,820 00

CHIEF IMPORTS, DUTIABLE.

Chemicals	38,156 00
Manufactures of cotton	186,559 00
Earthen, stone, and china ware	263,769 00
Fancy goods	143,279 00
Manufactures of flax	145,538 00
Fruits	188,254 00
Glass and glassware	58,157 00
Pig iron, 72,982,199 pounds	729,066 00
Band iron, 1,341,360 pounds	30,944 00
Railroad iron, 5,378,643 pounds	59,882 00
Old scrap iron, 17,419 tons	434,622 00
Hardware	8,522 00
Fire-arms	16,834 00
Steel ingots, bars, wire, &c	46,479 00

	Invoice value.
Steel rails, 13,418,073 pounds	$224,793 00
Steel cutlery, manufactures of steel, &c	310,121 00
Manufactures of marble	67,714 00
Musical instruments	64,197 00
Manufactures of paper	22,172 00
Potatoes	9,405 00
Salt, 123,194,799 pounds	221,898 00
Manufactures of silks	38,331 00
Sal soda and soda ash, 26,095,551 pounds	326,571 00
Caustic soda, 1,374,591 pounds	30,641 00
Manufactures of straw	17,872 00
Brown sugar, 17,267,438 pounds	811,689 00
Molasses, 1,282,182 gallons	260,523 00
Tin, 356,127 cwt	1,431,816 00
Wine in casks, 29,554 gallons	26,898 00
Wine in bottles	21,361 00
Cabinet ware, &c	16,383 00
Carpets	2,646 00
Cloths and cassimere	175,173 00
Dress goods	20,790 00
Manufactures of wool	23,479 00
Miscellaneous	858,462 00
	7,332,996 00

Duties collected	2,867,690 49
Duties due on merchandise in bond	151,236 13
Duties due on merchandise transported in bond with appraisement	57,679 83
Duties due on merchandise transported in bond without appraisement	162,670 41
	3,239,276 86
Currency from fees, &c	220,367 71
Total	3,459,644 57

Among the chief articles of import there has been an increase in quantity, as shown by the comparative statement following:

Articles.	1880.	1881.	Increase.
Chemicals	$36,927	$38,156	$1,229
Manufactures of cotton	155,613	186,559	30,946
Earthen, stone, and china ware	169,720	263,769	94,049
Fancy goods	113,347	143,279	29,932
Glass and glassware	33,690	58,157	24,467
Hardware	7,224	8,522	1,298
Fire-arms	7,469	16,834	9,365
Musical instruments	28,187	64,197	36,010

Articles.	Pounds.	Value.
Salt, 1881	123,194,799	$221,898
Salt, 1880	85,554,383	153,771
Increase	37,640,416	68,127
Sal soda and soda ash, 1881	26,095,551	326,571
Sal soda and soda ash, 1880	25,296,247	313,185
Increase	799,304	13,456
Caustic soda, 1881	1,374,591	30,641
Caustic soda, 1880	847,453	19,332
Increase	527,138	11,309
Brown sugar, 1881	17,267,438	811,689
Brown sugar, 1880	14,539,633	616,761
Increase	2,727,805	194,928

	Cwt.
Tin plate for 1881	356,127
Tin plate for 1880	312,606
Increase	43,521
Carpets for 1881	2,646 00
Carpets for 1880	616 00
Increase	2,030 00
Cloths and cassimeres, 1881	175,173 00
Cloths and cassimeres, 1880	166,857 00
Increase	8,316 00
Manufactures of wool, 1881	23,479 00
Manufactures of wool, 1880	12,201,00
Increase	11,278 00
Manufactures of papier-maché, 1881	22,172 00
Manufactures of papier-maché, 1880	11,441 00
Increase	10,731 00

Merchandise transported in bond with appraisement, at port of Baltimore, showing to what places sent as ports of delivery, with the value of the goods, and the amount of duty collectable thereon at said ports.

Place.	Invoice value.	Duty.
Pittsburgh	$197,343 00	$51,093 10
Wheeling	3,549 00	1,560 85
Chicago	8,930 00	3,572 38
Cincinnati	124 00	67 60
New York	2,094 00	1,385 90
Total	212,040 00	57,679 83

Articles so transported comprised iron, iron ore, scrap iron, speigeleisen, manufactures of steel, cutlery, pocket knives, brandy, beer, &c.

MERCHANDISE TRANSPORTED IN BOND WITHOUT APPRAISEMENT, AT PORT OF BALTIMORE (ACT JUNE 10, 1880), SHOWING TO WHAT PLACES SENT, THE VALUE OF THE GOODS, AND THE AMOUNT OF DUTY COLLECTABLE THEREON PAYABLE AT PORTS OF DELIVERY.

These importations are in the nature of continuing ones from the place of exportation through the port of Baltimore as a port of entry, to ports of delivery in inland portions of the country.

This class of importations increase yearly in extent and importance; they notably show the intimate relation this port sustains to the country, and are, indeed, destined to grow stronger and attain to a more widespread extent.

Name of place.	Invoice value.	Duty.
Cincinnati	$99,759 00	$37,335 42
Pittsburgh	227,882 00	79,138 69
Saint Louis	33,605 00	11,895 84
Chicago	51,983 00	21,167 55
Georgetown	15,823 00	7,093 92
Cleveland	884 00	229 30
Milwaukee	6,438 00	2,575 30
San Francisco	5,069 00	3,022 45
Louisville	580 00	212 60
Total	442,023 00	162,670 41

The above comprises the totals in value and duty of the merchandise shipped to the places respectively named. These totals, if separated into parts, would show entries for transportation for every week in the year, comprising a variety of merchandise, such as earthenware, china, toys, manufactures of leather, pipes, porcelain, musical instruments, glassware, wines, iron ore, steel blooms, &c.

Articles exported.

Articles.	Quantity.	Value.
Acids … pounds	295, 239	$11, 572
Plows, cultivators, &c … number	426	1, 932
Hogs … do	108	1, 500
Horned cattle … do	7, 502	688, 260
Horses … do	53	9, 805
Mules … do	89	11, 293
Sheep … do	2, 800	17, 087
Pot and pearl ashes … pounds	734, 745	86, 525
Bark		98, 532
Beer in bottles … dozen	9, 072	637
Blacking		6
Books, &c		10, 073
Brass, &c		46
Bread and biscuit … pounds	1, 186, 612	51, 702
Indian corn … do	11, 839, 216	6, 652, 123
Indian-corn meal … barrels	10, 878	32, 957
Oats … bushels	17, 988	8, 513
Wheat … do	34, 291, 794	39, 557, 276
Wheat flour … barrels	500, 726	2, 919, 352
Other grain and preparations, breadstuffs, &c		38, 592
Bricks		410
Brooms and brushes		1, 344
Candles, &c … pounds	42, 500	4, 254
Carriages, &c		4, 813
Clocks, &c		25
Coffee, spices, &c		21
Coal … tons	29, 086	114, 400
Copper, &c … pounds	97	39
Cordage, rope, &c … do	22, 740	3, 646
Cotton … bales	155, 374	8, 810, 271
Manufactures of cotton … yards	233, 838	25, 884
Drugs, chemicals, &c		57, 320
Dye stuffs		592
Earthern ware, &c		901
Fancy articles		182
Apples, dried … pounds	519, 135	24, 368
Apples, green … bushels	1, 675	1, 588
Canned fruit		25, 392
Furs, &c		4, 960
Gas fixtures		100
Glass and glassware		25, 080
Manufactured hair		90, 963
Do		19
Manufactured hemp		367
Hats, &c		17
Hides, &c		3, 000
Hops		22
Manufactures of gutta percha		80
Car wheels … number	238	1, 813
Castings		174
Stones, &c		676
Engine boilers		385
Machinery		10, 198
Nails and manufactures of iron		6, 728
Steel and manufactures of steel		[illegible], 812
Jewelry		654
Junk, &c		159
Lamps		287
Manufactures of lead		30
Manufactures of leather		10, 473
Lime and cement		75
Guano		40
Manures		539
Manufactures of marble		425
Matches		7, 273
Scientific instruments		51
Musical instruments		610
Naval stores		77, 484
Oil cake … pounds	10, 246, 482	156, 428
Oils, illuminating … gallons	13, 881, 990	1, 327, 989
Oils, lubricating … do	266, 235	50, 167
Oils, mineral and residuum … barrels	3, 584	7, 000
Lard oil … gallons	64, 483	45, 366
Whale and fish oil … do	9, 480	2, 939
Neat's-foot oil … do	27, 675	25, 676

Articles exported—Continued.

Articles.		Quantity.	Value.
Linseed oil	gallons	207	$134
Gunpowder	pounds	62	17
Hams	do	1,157,624	116,951
Paints			209
Paintings			21
Paper and stationery			4,407
Perfumery			293
Plated ware			130
Printing presses and type			900
Bacon	pounds	34,089,084	2,672,802
Beef, salted and cured	do	352,640	24,404
Butter	do	234,888	38,825
Cheese	do	644,479	65,406
Condensed milk			150
Fish, dried or smoked			1,127
Fish, pickled and cured			2,339
Lard	pounds	31,548,656	3,019,212
Meats, preserved			75,216
Oysters			55,537
Pickles and sauces			25
Pork	pounds	1,315,879	101,885
Onions			119
Potatoes			587
Vegetables			30
Vegetables, preserved			9,816
Rice			46
Salt			30
Scales			573
Clover seed	pounds	1,663,958	145,800
Cotton seed	do	424,681	4,350
Timothy seed			15,553
Sewing machines			1,202
Soap, perfumed, &c			3,237
Alcohol			736
Spirits turpentine			505
Starch	pounds	906,690	56,873
Sugar, refined	do	119,982	11,857
Molasses	gallons	11,845	2,682
Candy and confectionery			568
Tallow	pounds	3,413,843	219,943
Tin and manufactures of			31,673
Leaf-tobacco	pounds	51,535,442	3,710,402
Manufactured tobacco			66,172
Sailing vessels	tons	24,43	400
Wearing apparel			1,694
Wool and manufactures of			92,921
Shooks, staves, &c			119,989
Hogsheads and barrels	number	18,008	10,215
Lumber, &c			139,002
Logs, masts, spars, &c			128,205
Household furniture			6,439
Wooden ware			450
Manufactures of wood, miscellaneous			6,807
Manufactures of wool			76
Miscellaneous			347,832
Total			72,449,071

VESSELS ENTERING FROM FOREIGN PORTS.

American vessels	234
Tonnage	80,631
Foreign vessels:	
Sailing	985
Steam	314
Tonnage sailing vessels	662,420
Tonnage steam vessels	622,816
Total American and foreign vessels	1,533
Total tonnage	1,365,867

VESSELS CLEARING FOR FOREIGN PORTS.

American vessels	213
Tonnage	74,086

Foreign vessels:

Sailing	975
Steam	214
Tonnage sailing vessels	663,228
Tonnage steam vessels	614,647
Total number American and foreign vessels	1,402
Total tonnage	1,351,961
Vessels entering coastwise	1,274
Tonnage	987,845

Vessels clearing coastwise:

American and foreign	2,042
Tonnage	1,490,507

Included in the above are a number of steamships entering at this port and clearing coastwise in ballast for other ports.

Grand total of recorded tonnage traversing the harbor as above stated, 55,196,180 tons.

This summary of total tonnage does not include coasters not required to enter nor clear. If the amount could be ascertained it would largely increase the tonnage.

Number of steamships entering and departing the harbor about 620.

The increase in steamships in the merchant marine of this port affords a very significant proof of the vigor of its trade.

Amount of tonnage tax collected	$144,430 58
The registered tonnage comprises	1,041
Vessels, sail and steam, tonnage	99,739.46
Number of enrolled vessels in the coasting trade	714
Tonnage of same	73,561.87

EMIGRANTS AND PASSENGERS.

Passengers, native and alien	1,895
Emigrants:	
Male	22,265
Female	17,752
Total	40,017

An increase of nearly 21,000 over last year.

FOREIGN STEAMSHIP LINES.

"North German Lloyd," between Baltimore and Bremen, with freight to Bremen, Hamburg, London, Hull, Leith, Antwerp, &c.

"Allan Line," between Baltimore and Liverpool, London, Hamburg, Rotterdam, Amsterdam, Antwerp, Havre, Bordeaux, &c.

"Hooper's Line," between Baltimore and Liverpool.

"West India and Pacific Steamship Company," for Liverpool, Baltimore, and West Indies.

"Continental Line," for Rotterdam.

"Tully Line," for Newcastle-upon-Tyne.

"Great Western Steamship Line," between Baltimore and Bristol, England.

"Donaldson Clyde Line," steamers, Baltimore and Glasgow.

"Adamson and Donaldson Line," Baltimore and London.

A line from Baltimore to Liverpool direct, with occasional sailings for Belfast and Barrow. This line is composed of 10 first-class steamers.

There are a number of other lines in addition to the above-named.

The manner in which new lines of steamships have multiplied at this port affords a notable evidence of its prosperity.

New lines are now in contemplation. Negotiations are in progress for a line between here and France, and there is good reason to expect that it will be established. It is well assured, however, that a new line will very shortly be established between this port and Barrow; at the last-named place steamships are building of large size expressly intended for the transportation of cattle from this port.

The lines above named are composed of a large number of first-class steamships varying in tonnage capacity from 3,000 to 4,500 tons. The depth of water necessary for such vessels will be apparent. When fully loaded they draw from 25 to 27 feet.

SOME OF THE SEA-GOING COASTWISE LINES.

Boston Steamship Line, between Baltimore, Norfolk, Va., Boston, and New England points; Savannah Steamship Line, between Baltimore and Savannah, connecting with interior points in Georgia, Florida, and Alabama; "Baltimore and New Berne, N.C." between Baltimore and New Berne; "Merchant Steamship Company" for Charleston, S. C., and all points south.

BAY AND RIVER LINES.

Richmond, York River and Chesapeake Railroad Line.
Richmond, Va., York River, and points south.
Powhatan Line, freight steamers, for James River, Virginia.
Baltimore Steam Packet Company.
Old Bay Line, for Portsmouth and Norfolk, Va.

Besides which there are many other bay lines plying between this port and towns upon the Chesapeake Bay and its tributaries.

As collateral with the above statements, it is deemed proper to mention that the Baltimore and Ohio Railroad Company has erected at Locust Point, the water terminus of that road, an additional pier, about 700 feet in length and 40 in breadth. For the necessary accommodation of the increasing importations a commodious three-story brick warehouse, and a rail rack, with docks running the entire length on either side, has been placed in bond as a United States general-order store and warehouse.

There are now at this place three general-order stores and two extensive bonded yards for the storage of iron.

A third grain-elevator has been erected at this point. This is a large and magnificent structure, built with every modern and improved facility for moving grain. It has a storage capacity of about 2,000,000 bushels. The elevators at Locust Point furnish a storage for upwards of 4,000,000 bushels of grain. This fact, taken in connection with the three grain elevators at Canton, the terminus of the Northern Central Railroad, exhibits both the increasing demands of trade at this port and the liberal enterprise entered into here to accommodate those demands. Further extension of warehouse facilities has been determined upon at Locust Point.

In my communication of last year the improvements named above were mentioned as in contemplation. It is gratifying now to state that they have been completed. It is rumored that an additional grain elevator is to be erected at Canton, and it is not unlikely that the rumor will turn out to be correct, as the increasing demands of trade have met with liberal accommodation at that place.

While mentioning these improvements, for the purpose of showing the spirit animating this port as a commercial center, it is proper to state that the harbor of Baltimore is most admirably and efficiently equipped with a fleet of tug-boats. Liberal expenditures have been made in the structure of these valuable adjuncts to commerce, and within the last year several boats of this class, of large size and great power, have been built and put into service.

Before closing this summary, it is not deemed amiss to refer to the contemplated ship-canal intended to give this port a shorter way to the sea.

The merits of this contemplated enterprise it is not proper here to discuss. They are evidently well understood by the country; and it is gratifying to know that the project has grown into public favor, and has met with more than friendly support at the hands of Congress. It is mentioned here as a subject deserving a conspicuous place in a communication of this character, and as in the nature of an appeal in its behalf; and also for the purpose of referring to some facts coming under my notice having some relation to the necessity of the enterprise. It will be seen by these statistics that through this port importations are made to various parts of the country. Now, these importations must necessarily increase. This port, from its central location and natural relations to a large extent of inland country, must become the frontier port through which foreign supplies will come to reach that country. It is plain, therefore, that in giving Baltimore nearer approaches to the sea the benefit that inures would be widespread. It is furthermore observable from these statistics that there is a large sea-going coastwise trade maintained with Atlantic cities, besides which many vessels (sailing and steamship) during the course of a year leave this port for other ports for cargo, and correspondingly leave other ports for this for cargo. This is in the nature of commercial trade, for there are interests in that trade identical here and at northern Atlantic cities.
whole length of the bay, to get north, is very great.

The cost to owners of vessels (some large class steamships in ballast) to traverse the

The saving of outlay in the matter of coastwise trade and in, that vessels ordered from or to this port to northern ports for cargo, would be immense, and would distribute itself alike to this and other ports.

This view has been presented in a former communication upon this subject, but as the facts repeat themselves year after year, it was thought the repetition of them was fully justified by the gravity of the interest concerned.

One other matter relatively connected with the subject deserves, at least, a passing reference. In order to bring it to notice a recurrence to Locust Point will be necessary. This is an important place for the commerce of Baltimore; the chief shipping business of the port has gravitated there, and given it a valuable importance. Every foot of its water front is now occupied down to the line of Fort McHenry, adjoining the dry dock.

Fort McHenry now, because of its surroundings, becomes the key to the commerce of the port, as it was the key to the harbor in former war-times. That portion of the fort tract between the line of the dry-dock and the point of the peninsula, from the land line to the harbor line, is said to contain about 8 acres. This is valuable to the government, but is of itself intrinsically valuable. It could be utilized in the interest both of the government and the commerce of the port, by the erection of piers and docks to be used as general order stores. No natural advantages like these are possessed by the government elsewhere. Difficulties have often arisen in making disposition of cargoes under general order, because of the cost of drayage to government public stores; here the government has property, right at the threshold of the harbor, where ships could be docked and unladen.

The necessity for such a general-order store may become absolute as the commerce of the port continues to expand.

The agents of the government at ports of entry are sometimes embarrassed in taking possession of cargoes under general order because there is no bonded house convenient in which to store it. With a public store so elligibly situated at the entrance to the harbor, advantages would accrue to the government and to commerce of great value.

It is not intended by a reference to this matter to recommend any plan relative thereto, but merely to refer to it and its commercial bearing as a subject deserving consideration.

In conclusion it is gratifying to me to present a summary of the commerce of this port for the fiscal year that so flatteringly shows the vigor of that commerce and the valuable and important relation this port sustains to the country generally.

I am, sir, very respectfully,

JOHN L. THOMAS, Jr.,
Collector.

Col. WM. P. CRAIGHILL,
United States Engineer.

G 8.

IMPROVEMENT OF THE HARBOR OF ANNAPOLIS, MARYLAND.

The following special report was made November 10, 1880.

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., November 10, 1880.

GENERAL: The law of June 18, 1878, required a "survey of the bars at the entrance to Annapolis Harbor, Maryland, with a view to the accommodation of deep-draught vessels at low-tide." The survey was made in September, 1878, as detailed as the funds available would allow, and a report was submitted dated January 8, 1879, which may be found printed in the Annual Report of the Chief of Engineers for 1879, Part I, beginning at page 574.

In that report an estimate was presented of the cost of connecting the deep water of the bay with the deep water of the Severn River, and thus permitting "vessels of deep draught" to pass over "the bars at the entrance" and come into the "harbor of Annapolis." The channel estimated for was 150 feet in width and 24 feet in depth at mean low-water. This width was considered the minimum that would suffice, and this upon the supposition that it would be used only by steamers or by sailing vessels towed by tugs.

The probabilities being generally against the permanence of a dredged channel, unless auxiliary works be added for the purpose of concentrating the flow of water in it, the opinion was expressed that it might be found necessary to construct such works, either with the object just stated or to intercept matter in motion which might otherwise fall into the dredged channel and reproduce the bars, and that more time should be devoted to the study of the locality to decide, first, whether such auxiliary works were necessary, and, secondly, what should be the location, extent, and style of construction, if necessary.

In the law of June 14, 1880, Congress directed an examination of the "bars at the entrance of Annapolis Harbor, with a view to ascertain the character of jetties necessary to render the proposed improvement permanent." The additional examination deemed necessary has been made by Mr. W. R. Hutton, a civil engineer of skill and experience. His report, dated October 30, 1880, is appended hereto. It appears that the cost of jetties would be quite large—out of proportion to the probable benefit to be obtained by them, and further study has resulted in a change in the position proposed for the channel to be dredged, such that it is believed greater permanence may be expected. As stated by Mr. Hutton, "some dredging will doubtless be required in course of time." The extent of it can only be known from observation. The probabilities are that the annual cost of such dredging would be less than the interest on on the large sum which jetties would cost.

The new position for the channel has been laid down on the map which accompanied the report of 1878. Besides the improvement claimed for it above, it will be observed that it is more convenient for use by vessels moving between Annapolis and the lower bay, the portion of it where vessels of deep draught approaching or leaving Annapolis are most likely to be found.

The width and depth of the channel now estimated for are unchanged. It is calculated that to dredge a channel 150 feet wide at bottom, and 24 feet deep at mean low-water, would require the removal of 330,000 cubic yards of material, at a cost of $66,000. As the estimate is for a minimum channel, the whole amount should be appropriated in one sum, if at all.

The law states that—

"In every case where examinations or surveys are made, the report thereon shall embrace such information concerning the commercial importance, present and prospective, of the improvement contemplated thereby, and such general commercial statistics as the Secretary of War may be able to procure."

As to this branch of the subject, I have no better information than is found in the papers appended to the report of 1878, already referred to, which may be seen on pages 578 and 579 thereof, and to those papers attention is invited, viz, the letters of City Counsellor Iglehart and Admiral Rodgers, U. S. N., and the report of Capt. C. B. Phillips, Corps of Engineers, U. S. A.

Very respectfully, your obedient servant,

WM. P. CRAIGHILL,
Major of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. WILLIAM R. HUTTON, ASSISTANT ENGINEER.

BALTIMORE, MD., *October* 30, 1880.

SIR: I have the honor to report the result of an examination of the bars at the entrance to Annapolis Harbor, made with a view "to ascertain the character of the jetties necessary to render the improvement permanent."

The improvement referred to is that proposed by Captain Schuyler, United States Engineers, in 1878, and would consist of a dredged channel 150 feet wide at bottom and 24 feet deep at low-water, extending from deep water of the Severn off the United States Naval Academy to the 24-foot curve in the bay.

A number of observations upon tides and tidal currents have been made, some few soundings outside the limits of Mr Seagar's map of 1878, and the question has been studied to some extent upon the ground.

The range of tide is small (from 0'.65 to 1.05 during the short period covered by the observations), and is greatly affected by the wind as to range and the direction and force of currents.

The tidal wave passes up the bay at the rate of about 12 miles an hour. The ebb current sets down along shore from half an hour to two hours earlier than in the middle of the bay, and similarly the flood begins along shore some time before the turn of the tide in the bay. It was at times observed to turn on the bottom earlier than on the surface, so that a deep float would show quite a strong flood current while it was slackwater on the surface.

As far as I can learn, the exposed shores of the bay for miles above this place are undermined and carried off by the action of the waves during storms, and the material goes to extend the shoals along the bay shore. Horn Point, also within the harbor but exposed to easterly gales, is wasting away at an uncertain rate, according to some of the watermen 50 feet in twelve or fifteen years, or, so far as can be determined by comparison with the coast survey charts, about 100 feet in thirty-six years. A great portion of this material is probably dropped very near the place whence it is eroded.

The main tidal currents, that is, the channel currents, after the tide is well turned. either of flood or ebb, take the general direction from the mouth of Severn to Tally's

Point, sometimes showing a tendency to follow the south shore line into the deep bights it forms. Their velocity is about half a foot per second.

The Severn River opposite and above the Naval Academy, confined between banks 2,000 feet apart, has ample depth. The currents of the ebb and flood maintain a depth of 24 feet into the wider expanse of the harbor, 3,600 feet beyond the wharf of the academy. Here, being weakened by diffusion, the water shoals to 18 feet. They are again concentrated between Horn Point and Greenberry Point bars, and the depth again increases to 20 feet, which is maintained for a distance of a mile, 1,800 feet of it being 24 feet deep. Outside the bars it shoals to 18 feet, and then gradually increases in depth to the deep water of the bay.

The curve of 24-foot depth outside of the harbor may be said to follow the general line of the bay, uninfluenced by Severn River. The 20-foot curve, by a decided inflexion toward the shore, marks the point where the current of the Severn makes itself felt.

Both of these curves have moved slightly away from the shore since 1844, the date of coast survey by hydrography, except where the former crosses the line of Severn River. At that time the 20-foot curve extended in a narrow loop 2,500 feet farther into the harbor, indicating a scour on the line of the river current. The bottom is so flat, however, that the total filling at this point in thirty-six years has been but 1 foot in depth.

But from Tally's Point a shoal extends about east-southeast into the bay a distance of 6,600 feet, on more than 5,000 of which the water does not at low-tide exceed 4 feet in depth, and in a great part of it much less.

This shoal, which now extends 1,000 feet beyond its end in 1844, does very materially affect both the 20 and the 24 foot curves, pushing them far out into the bay. It appears to be formed by the early ebb-tide from the Severn meeting the flood-tide still running in the bay, aided by the direction given to the flood-tide along shore, which, following the curve of the deep bight below Tally's Point, there leaves it in a direction nearly parallel with the bar or "reef." The ebb, when fully established, flows across the bar with a velocity of 2 feet per second. This I suppose to be the surface current taking the shortest way across the obstruction, while the deeper currents are deflected by the "reef," as by a training-wall, and pass along it and around its end.

The foregoing are the facts bearing upon the question. From them and an inspection of the map, I conclude that the new channel should be laid in a straight line from the closed curve of 24 feet depth between Greenberry and Horn Point bars, to that point on the 24-foot curve outside when it turns from the shore to pass around the reef off Tally's Point. To confine this channel between two jetties would be injurious by obstructing the ordinary navigation of the harbor.

A single jetty on the south side would confine the current more closely, and would better maintain the channel. Its length would be very great, and its cost out of proportion to the benefits to be obtained.*

A channel dredged on the line I have described would, in my judgment, maintain itself. The changes in the bottom along the line of it are very slight in the 36 years over which our references extend. The place most liable to shoal is between the river mouth, at the Naval Academy Wharf, and Greenberry's Point. The wide openings on either side, into which Spa and Carr's creeks empty, reduce the scouring power of the current and explain the shoaler water at this place. But the channel will be directly in the line of the main tidal currents to and from the Severn, a slight bottom velocity will be directed along it by the new dredged channel, and a less velocity is needed to maintain than to erode a channel. There are no cross-currents here or farther out, but all are in the direction of the channel. It is true that the tidal current down the bay has a direction across the channel, but I think that only the surface currents continue in their line of direction across the "reef," the deeper ones, being deflected, aid those of the Severn in maintaining depth along the up-stream margin of the "reef."

Some dredging will doubtless be required in course of time, but it will be very much cheaper than any works to maintain the channel by scour.

The total dredging to make the proposed channel 150 feet wide on bottom as proposed by Captain Cuyler, a width, in my judgment, ample, is 325,800 cubic yards of soft material.

If this were sand or other heavy earth, it could be dumped in the bight between Horn Point and Skull Hall, with economy and great advantage, but I should fear to deposit there soft mud. It should be carried into the deep water of the bay at least 3,000 feet outside the line of the buoys on Hackett's and Tally's Point shoals. This will require the material to be transported an average distance of 2.7 miles, an extreme distance of about 3¾ miles.

The "reef" off Tally's Point extends about 6,600 feet from shore, and to within 12,000 feet of shoal water on the Kent Island side of the bay. It has advanced considerably since 1844, and the depth upon it, then from 4 to 7 feet, is now, over the same places, from 2 to 4 feet. Whether the bar or "reef" as it is called, has yet acquired a position of permanency, is not known. Its effect upon the proposed channel is advantageous, except in so far as it increases the length of it. A low dike along a portion (4,000 feet) of it would increase the scour in the proposed channel, but at the risk of extending the "reef" still farther into the bay. It is therefore, undesirable, as it is unnecessary.

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* Length about 17,000 feet; cost, roughly, $400,000.

Respectfully,

W. R. HUTTON.

Two appropriations have been made for this locality, each of $5,000, June 14, 1880, and March 3, 1881. As the expenditure of $10,000 would not affect any substantial improvement, it did not seem expedient to commence operations until further directions were received from Congress. Recommendation to that effect to the Chief of Engineers, made April 1, 1881, was approved April 7.

Money statement.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		794 02
July 1, 1881, amount available		9,205 98
Amount (estimated) required for completion of existing project		56,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		56,000 00

INFORMATION AS TO THE COMMERCE OF ANNAPOLIS, FROM MR. IRELAND, COLLECTOR, RECEIVED THROUGH HON. J. L. THOMAS, COLLECTOR OF BALTIMORE.

In reply to yours of May 28, I beg to say, that the advantages which would accrue to the government by the contemplated improvement of Annapolis Harbor would be many and great, especially so with regard to the customs.

As it now is, there is not sufficient depth of water to accommodate the large freighting vessels carrying coal, lumber, building materials, and other necessary commodities used here by the consumption of citizens, as well as the demand at the United States Naval Academy, and the consequence is, except such small quanlities as can be brought by small vessels, for the most part, these things are conveyed by rail as a matter of necessity, and because of the existence of this fact we have no vessel of large draft of water licensed from this port and are unable to give such statistics as are desired.

The advantage of the improvement to the general government may be estimated when it is remembered that the Naval Academy is located here, and the consequent necessity of vesels going back and forth, only the smaller of which are able to enter the harbor, and only at full tide, and in the custody of tows, and it often occurs that under such precautions even then they are grounded.

G 9.

IMPROVEMENT OF THE CHOPTANK RIVER, BETWEEN DENTON AND GREENSBOROUGH, MARYLAND.

A survey of this portion of the Choptank River was made in 1879, and a detailed report presented thereafter, which was printed in full in the Annual Report of the Chief of Engineers for 1880, beginning at page 634. An estimate was given of $79,000 for dredging a channel 75 feet wide and 8 feet deep at mean low-water. It was stated, however, that the cost would be much reduced if the proposed depth were made 7 feet instead of 8. On a re-examination made in October, 1880, it was found that a channel of 6 feet depth at mean low-water, as high as Case's wharf, which is a short distance below Greensborough, would cost $40,000.

Congress appropriated $5,000 June 14, 1880. It was decided to apply this to a beginning of the 6-foot channel, at a point 400 feet below Case's wharf, following the lines of the channel through the shoal to a point above Brick Mills, where the 6-foot curve above has a width of 75 feet, and connecting the 6-foot curves with a cut 3,000 feet long.

It was provided that the material excavated should be deposited on one or both sides of the river, either upon the shores above high-water mark, upon solid marsh, or in "cripples" 20 feet from their nearest edge, or upon flats submerged at high-water not less than 80 feet from the nearest edge of the cutting, in localities to be approved by the engineer in charge, and to be procured without expense to the United States in any manner whatever.

The material to be removed was found to be sand and mud. The depth of cutting was found to vary from 0.8 foot to 3.1 feet, averaging about 1.7 feet.

A contract was made for this work in November, 1880, with Mr. D. Constantine, of Baltimore, at the rate of 23 cents per cubic yard for material excavated and redeposited in accordance with the specifications, measured in scows or embankments, or 27½ cents measured in place.

A second appropriation of $5,000 was made by Congress March 3, 1881. A contract for its expenditure has been entered into with the same contractor and at the same price as the first. Work under the first contract is to be completed July 31, 1881, the amount of material to be removed being about 17,500 cubic yards measured in place. Work under the new appropriation is to continue immediately after the exhaustion of the old. It is expected to carry the new channel for an additional length of about 1 mile.

Money statement.

July 1, 1880 amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		331 00
July 1, 1881, amount available		9,668 31
Amount (estimated) required for completion of existing project		30,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		10,000 00

Abstract of proposals for dredging Choptank River, Maryland, opened at 12.30 *p. m., November* 30, 1880.

No.	Name.	Residence.	Time.		Price per cubic yard.	Remarks.
			Commence.	Complete.		
1	George W. Parsons.	Salisbury, Md.	Jan. 15. 1881	Aug. 1, 1881	$0 28	Measured in place.
2	Daniel Constantine.	Baltimore, Md.	Mar. 1, 1881	June 30, 1881	23 27½	Measured in scows Measured in place.

Contract with Daniel Constantine.

Abstract of proposals for dredging in the Choptank River, Maryland, opened at 12.30 *p. m., June* 30, 1881.

No.	Name.	Residence.	Time.		Price per cubic yard.	Remarks.
			Commence.	Complete.		
1	Daniel Constantine.	Baltimore.....	On completion of present contract.	Oct. 31, 1881	$0 27½	Measured in place.

Contract with D. Constantine.

REPORT OF MR. GEORGE W. PARSONS, ASSISTANT ENGINEER.

SALISBURY, MD., *October* 4, 1880.

COLONEL: I have the honor to submit the following report of an examination of the upper portion of Choptank River between Denton and Greensborough, in Caroline County, Maryland, in accordance with your instructions of September 23.

Choptank River is navigable for bay steamers as far as Denton, 7½ miles below "Case's," the lower wharf at Greensborough, and about 3½ miles above Denton, for such sailing vessels as are engaged in carrying on the commerce of Greensborough and the Choptank generally. Above this point the river formerly possessed depth of water sufficient for navigable purposes to its headwaters now spanned by a wooden bridge. Sweeping away of mill-dams by freshets and washing of lands cultivated to the edge of the stream have operated to form shoals at several points, also to fill the bed of the river in its upper portion to such an extent as to necessitate lighterage of all products shipped or received by this outlet from the present anchorage to Greensborough, a distance of over 4 miles. At several points the depth of water on the shoals is so little that lighters ground on them at high-water. This, with the detention from head tides, renders shipments by water both tedious and expensive.

Doubtless great relief would be experienced by the town and a large surrounding country by establishing navigation to Greensborough. It would again renew their once extensive grain and ship-building trade.

I have ascertained that vessels now navigating the river pass over without detention portions of the Choptank lying above and below Denton, where there is but 6 feet of water at low-tide. I consider that depth of water sufficient for the necessities of trade. For improving the river I would suggest constructing a channel 75 feet wide, 6 feet deep at low-water, from the present anchorage (Passapor's wharf) to Case's wharf below Greensborough, the cost of which would be about $40,000. I also suggest, as a first step towards the ultimate completion of this project, the expenditure of the $5,000 appropriated at the last session of Congress for the improvement of this river in dredging a channel 75 feet wide, 6 feet deep, from the ending of 6 feet water above Passapor's landing through the shoals below Brick Mill, a distance of 3,800 feet, to connect with the existing 6-foot channel above that shoal. To dredge this channel requires the removal and redeposit of 17,500 cubic yards of material at an estimated net cost of $4,400.

The effect of this channel would be to enable vessels to anchor 1½ miles nearer Greensborough than at present, also removing a troublesome bar to lighterage.

Subsequent appropriations are relied upon for the final completion of the entire channel as suggested.

I am indebted to your report to the Secretary of War, January 23, 1880, for information relating to the Choptank River, and the towns of Denton and Greensborough, also to the survey and map of Assistant Engineer J. L. Seager, from which the above distances and estimates are computed.

Very respectfully, your obedient servant,

GEORGE W. PARSONS.

Lieut. Col. WM. P. CRAIGHILL,
Corps of Engineers.

COMMERCIAL STATISTICS.

The following statistics as to the commerce on the river are believed to be reliable:

The trade of this portion of the Choptank River is carried by three schooners owned in Greensborough, of an aggregate tonnage of 270 tons (custom-house register). These three schooners ply regularly between the "The Stakes" and Baltimore, making an average of thirty round trips each annually.

Two other schooners, of 100 tons capacity each, are chartered during busy seasons, averaging about ten trips yearly.

SHIPMENTS DURING THE YEAR 1880.

Grain	bushels	150,000
Timber (sawed)	feet	400,000
Railroad ties (estimated)		20,000
Lime (received)	bushels	50,000
Shells	do	300,000
Fertilizers	tons	300
Coal	do	200

Merchandise, building materials, &c., for the supply of a district comprised within a radius of 6 miles around Greensborough.

This produce is carried from Greensborough to "The Stakes," a distance of 7 miles, on open scows or lighters, at a cost of 1 cent per bushel for grain and proportionate cost for other produce, and also at considerable risk of loss from exposure to the weather.

SHIPMENTS BY RAILROAD, 1880, FROM GREENSBOROUGH.

Grain	bushels	35,000
Peaches	boxes	50,000
Canned goods	cans	700,000
Evaporated fruit	pounds	100,000
Lumber	feet	500,000
Berries	buckets	10,000
Eggs	dozen	15,000
Poultry	pounds	75,000
Wool	do	10,000
Live stock	do	200,000
General merchandise (received)	do	300,000
Coal (received)	tons	500
Lime (received)	bushels	5,000
Phosphate and phosphate material	tons	250

This trade goes to Philadelphia and New York at heavy rates for freight.

Arrangements are being made for running a steamer at an early date between the Brick Mill Landing and Baltimore.

G 10.

IMPROVEMENT OF SECRETARY CREEK, MARYLAND.

Before 1877 not more than 4 or 5 feet of water, perhaps not so much, could be carried up to the upper wharf, about 1½ miles from East New Market. In that year a fund was raised by subscription, and between $4,000 and $5,000 were spent in dredging to a depth of 7 or 8 feet at mean low-water. Not as much dredging could be done as was needed.

The first appropriation by Congress was of $3,000, made June 14, 1880. After some difficulty in getting suitable proposals for the work, a contract was made with the American Dredging Company, of Philadelphia, at the rate of 18 cents per cubic yard for material measured in scows for dredging and redepositing. Work was not commenced until April 25, 1881.

Meantime, Congress had made another appropriation of $3,000, March 3, 1881. A contract was soon made with the same parties as before, but at an advance in price of 2 cents per cubic yard. Work under both contracts was completed May 26, 1881.

Previous to the work done by the United States the navigation of this short creek was difficult, owing to the narrowness of the channel and its very sharp bends. The curvature of these sharp bends has been very much lessened, and the channel is now nowhere less than 100 feet in width. A commodious turning-basin has been made near the town wharf with an area of about 40,000 square feet. The excavation has been to a depth of 7 feet at mean low-water. The material dredged has been chiefly soft mud, with some admixture of sand. The total quantity removed has amounted to 29,215 cubic yards, measured in the scows. It has been deposited in the coves near the mouth of the creek, whence it could not run back again into the channel.

There is a daily line of steamers on this creek running to other points on the Eastern Shore and to Baltimore.

Other steamboats navigate the creek occasionally, and there are several small sailing vessels trading to Baltimore.

There are considerable shipments of grain, and the freighting during the fruit season is very heavy.

Money statement.

July 1, 1880, amount available	$3,000 00	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$6,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		5,806 24
July 1, 1881, amount available		193 76

Abstract of proposals for dredging Secretary Creek, Maryland, opened at 11.30 a. m., August 17, 1880.

No.	Name.	Residence.	Time.		Price per cubic yard.	Remarks.
			Commence.	Complete.		
1	Daniel Constantine.	Baltimore	Jan. 1, 1881	June 30, 1881	$0.28	Measured in scows.

Rejected; too high.

Abstract of proposals for dredging Secretary Creek, Maryland, opened at 11.30 a. m., November 30, 1880.

No.	Name.	Residence.	Time.		Price per cubic yard.	Remarks.
			Commence.	Complete.		
1	American Dredging Company.	Philadelphia	April 30, 1881	June 30, 1881	$0 18	Measured in scows.
2	E. W. Ferris	Baltimore	May 15, 1881	July 1, 1881	23¼	Measured in scows. Conditional on being allowed to dump in deep water.
3	Daniel Constantine.	do	Dec. 15, 1880	Feb. 1, 1881	25 29½	Measured in scows. Measured in place.

Contract with American Dredging Company.

Abstract of proposals for dredging Secretary Creek, Maryland, opened at 11.35 a. m., May 3, 1881.

No.	Name.	Residence.	Time.		Price per cubic yard.
			Commence.	Complete.	
1	American Dredging Company	Philadelphia	Dec. 15, 1881	Mch. 15, 1882	$0 2[illegible]

Contract with American Dredging Company.

G II.

IMPROVEMENT OF THE HARBOR OF CAMBRIDGE, MARYLAND.

The plan of improvement was to make a channel from the deep-water of the Choptank to the railroad wharf in the inner harbor, and to increase the dimensions of that harbor, the outer channel to be not less than 100 feet wide, and the depth of all the dredging to be 8 feet at mean low-water. This plan has been successfully carried out. The last work was completed in March, 1879. The balance of funds still available is held unexpended at present.

Some of the leading citizens of the town are desirous to have more enlargement of the harbor and its approaches. The necessity of this can only be judged of when a resurvey is made, which is expected to be undertaken before the meeting of Congress.

The results will be communicated in a special report if required.

Money statement.

July 1, 1880, amount available	$2,698 10
July 1, 1881, amount available	2,698 10

COMMERCIAL STATISTICS.

The following statements are the most reliable that can be procured as to the tonnage and commerce of the place:

STATEMENT OF SECRETARY AND TREASURER OF CAMBRIDGE MANUFACTURING COMPANY.

CAMBRIDGE, MD., *May* 27, 1881.

Number of vessels doing business in Cambridge Harbor for the year ending May 1, 1881:

Regular steamboats, making daily trips	4
Transient steamboats, excursions, &c	25
Regular schooners, weekly, &c., 35 to 150 tons	10
Transient schooners, for charter, repairs, &c	250
Regular sloops, weekly and semi-weekly, 10 to 15 tons	40
Transient sloops, charter, for repairs, &c., 10 to 15 tons	50
Regular canoes, &c., under 10 tons	50

Route up and down the river and bay to Baltimore. There are now at this point three ship-yards and two marine railways, full of business, occupying the harbor to a considerable extent with vessels repairing and waiting for repairs.

There are constantly in the harbor from thirty to seventy vessels of different classes and sizes. This has grown from one schooner weekly and one steamboat twice a week to the above proportions.

The business of the harbor has largely increased during the past year.

There being no record kept, the above is estimated, different opinions being taken, compared, and revised, and is perhaps as correct as may be without actual data.

Very respectfully,

W. C. CARMAN,
Secretary and Treasurer Cambridge Manufacturing Company.

STATEMENT OF THE POPULATION AND COMMERCE OF THE TOWN OF CAMBRIDGE, THE COUNTY SEAT OF DORCHESTER, MARYLAND.

CAMBRIDGE, MD., *July* 1, 1881.

The population at present is 2,500, having increased 50 per cent. within the past eight years. There have been erected thirty-four substantial buildings, including eight stores, the past year. There is now in course of construction seven dwellings and two stores.

East Cambridge, which is connected with Cambridge by a bridge across Cambridge Creek, has a population of 200; it has forty-one dwellings, including several fine residences and two stores; a large flour and hominy mill with an elevator attached, has a capacity for storing 15,000 bushels of grain; a steam saw and planing mill; there are now being erected a church and several dwellings; *it has grown to its present size since the opening of the harbor.* It is the western terminus of the Dorchester and Delaware Railroad, which extends to Seaford, Del., and has a connection thence with Philadelphia and New York.

A great quantity of grain, fruit, oysters, and merchandise is transshipped here, both for the interior and coastwise.

The large and elegant steamers running here attract many travelers from Washington and Baltimore *en route* to Ocean City on the peninsula, a much-frequented seaside resort.

The number of passengers and value of property transshipped from this point is greater than any town in Eastern Maryland.

Its importance has increased in consequence of the great increase of agricultural productions (which by the last census has more than doubled) in the surrounding country, and the consequent extension of commercial business. The ship-building business has more than quadrupled, and it is highly important to the commerce of the Choptank that its harbor should be kept in good condition, and enlarged to meet the increased demands of the shipping interest and traveling public. Over 32,900 persons passed to and from this point, during the past year, by the steamers alone. Over seventy boats (from 3 to 10 tons) were engaged here the past season in the oyster business catching and shipping to this point, besides nine sloops and seven pungies, whose aggregate tonnage was over 1,200 tons.

There were loaded here five schooners, for Maine, with timber (white oak), whose tonnage was 1,750; eight schooners loaded, for Baltimore, with timber, tonnage 1,500; three schooners for Philadelphia with timber, tonnage 750. There are three large steamers running daily between this point and Baltimore, tonnage 1,775; there is one tug (16 tons); making total tonnage of steam vessels 1,791; besides there are, during the summer season, twenty steamers bringing excursions, tonnage 12,000. There are two vessels running regularly, making semi-weekly trips as a packet, tonnage 270; these two boats alone shipped from here 71,000 bushels of grain. There were built eleven boats, tonnage 880. There are now being built five boats, tonnage 2,290. There came here for repairs one hundred and seventy-five boats, tonnage 14,000. Total tonnage of steam and sailing vessels, 36,731.

STATEMENT OF THE BUSINESS OF CAMBRIDGE.

There is a national bank, savings bank, and building and loan association with capital, deposits, &c. (all these have only been in operation a little over six months), of over $156,000; there are 62 stores, annual sales, $604,810; shucked and canned oysters shipped, $210,700; timber shipped, $65,000; tobacco factory, $10,000; wool, cattle, fur, tallow and hides, $32,540; grain, wheat, and corn, shipped, $100,000; lumber, $65,000; coal, $10,400; ship-building and repairing boats, $65,000; fertilizer and lime, $25,000; peaches shipped, $20,000; bricks, $5,000. Freight collected from steamers, $30,000. Cambridge manufacturing company, lumber, flour, hominy, feed, &c., $150,000, making the total business of Cambridge from June 1, 1880, to June 1, 1881, $1,484,450.

The peach crop was almost a failure last year, for by comparing the crop of 1879 with 1880, there was a falling off from this source of revenue of over $50,000. The oyster business is generally much better than last year; the river was frozen over for more than a month, which stopped the business entirely for that period; consequently there is a falling off from this source. There were nearly 300,000 bushels of oysters shucked and shipped from here the past season.

ALFRED STUART.

G 12.

IMPROVING TREADHAVEN CREEK, MARYLAND, FOR THREE MILES BELOW EASTON POINT.

The first appropriation for this creek was made June 14, 1880, $3,000. This it was proposed to expend in straightening the channel and in giving it a uniform depth of 7 feet at mean low-water, with a width of about 75 feet.

The material to be removed was found to be chiefly sand and soft mud.

The rise of tide is about 2 feet. The work was advertised July 22, 1880, but no contractor could be had at a reasonable price. It was advertised a second time in November, 1880, and a contract was made with the lowest bidder, the American Dredging Company, of Philadelphia, at the rate of 20 cents per cubic yard, measured in scows. The severe winter soon came on and nothing could be done for several months.

A second appropriation of $3,000 was made March 3, 1881. The work under it was advertised in April and a contract made with the same contractors as before, at a little advance in price, namely 22 cents per cubic yard.

Work under both contracts was begun June 2, 1881, and completed July 2, 1881. The total number of cubic yards removed was 27,094; of which about half were deposited up Back Creek, about 1,600 feet from its junction with Treadhaven Creek; about 10,500 yards were deposited opposite Peach Orchard Cove, and the remaining 4,000 yards in Playtor's Cove, about 1,200 feet from its mouth. The deposition was so made as to avoid danger of the material becoming an obstruction to navigation in any way, or being injurious to riparian owners.

The result of the work has been the making of a channel not less than 150 feet wide, 8 feet deep at mean low-water, up to Easton Point, and a turning-basin has been excavated there with an area of 135,000 square feet. The channel has also been made less crooked. The owners of wharf property availed themselves of the presence of the dredge to make e improvements at their own expense.

Money statement.

July 1, 1880, amount available	$3,000 00	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$6,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		3,016 34
July 1, 1881, amount available		2,983 66

Abstract of proposals for dredging Treadhaven Creek, Maryland, opened at 11 *o'clock a. m., August* 17, 1880.

No.	Name.	Residence.	Time.		Price per cubic yard.	Remarks.
			Commence.	Complete.		
1	Daniel Constantine.	Baltimore.	Mar. 1, 1881	June 30, 1881	$0 33	Measured in scows.

Rejected; too high.

Abstract of proposals for dredging Treadhaven Creek, Maryland, opened at 11 *o'clock a. m., November* 30, 1880.

No.	Name.	Residence.	Time		Price per cubic yard.	Remarks.
			Commence.	Complete.		
1	American Dredging Company.	Philadelphia..	Mar. 15, 1881	June 30, 1881	$0 20	Measured in scows.
2	E. W. Ferris.	Baltimore.....	April 1, 1881	July 1, 1881	29¾	Do.
3	Daniel Constantine.	....do	Dec. 15, 1880	Feb. 1, 1881	24 28½	Do. Measured in place.

Contract with American Dredging Company.

Abstract of proposals for dredging Treadhaven Creek, Maryland, opened at 11.05 *a. m., May* 3, 1881.

No.	Name.	Residence.	Time.		Price per cubic yard
			Commence.	Complete.	
1	American Dredging Company.......	Philadelphia	Dec. 15, 1881	April 15, 1882	$0 22

Contract with American Dredging Company.

INFORMATION AS TO THE COMMERCE OF THE TREADHAVEN CREEK, RECEIVED FROM HON. J. L. THOMAS, COLLECTOR OF BALTIMORE.

Easton Point, which is practically an extension of Easton City, is virtually the port of that place. Easton is a very substantial, thrifty town. An active trade is maintained, both in salable commodities and in the industry of the factory. A rail road passes through it, and there is a passenger and freight station, with all th- conveniences that attach. This road brings Easton in communication with Northern cities.

This town has a population of 3,000 inhabitants, and gives most encouraging promise of prosperity. In time Easton will doubtless extend itself to Easton Point.

At the last-named place, four steamboats ply between it and Baltimore, and also a considerable number of sailing vessels. A large trade in grain, fruit, lumber, coal. and various commodities is conducted here. Several factories are in successful operation for fruit-canning and other purposes.

The section of country for which the above-named water-course is an outlet is an improving one; it is a grain and fruit-growing section, yearly becoming more so.

G 13.

WATER-PASSAGE BETWEEN DEAL'S ISLAND AND LITTLE DEAL'S ISLAND. MARYLAND.

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., November 26, 1880.

GENERAL: Among the localities designated in the river and harbor act of June 14, 1880, to be surveyed or examined was the "water-passage between Deal's Island and Little Deal's Island, Maryland."

These islands are on the eastern side of Chesapeake Bay, quite near the mainland, just off the mouth of Manokin River, and opposite the inside entrance of Holland's Straits. The parallel of 38° 10′ just touches the upper end of the larger island. The "water-passage" between the two islands is usually called the Lower Thoroughfare, to distinguish it from the upper passage or thoroughfare which separates the upper island from the mainland. Many consider the upper passage much more important and worthy of improvement than the lower.

A description of the islands and of the passage between them is given by Mr. G. W. Parsons, who made the needed examination in October, 1880. A copy of his report is herewith, dated November 10, 1880. The water between the islands is quite shoal, as appears from Mr. Parsons' report and map, the former of which also gives a good idea of the "commercial importance, present and prospective," of such an improvement, if any, as might be made there. It is estimated that to dredge a channel 100 feet wide and 7 feet deep, at mean low-water, from Tangier Sound along by the wharves of Daniel and of Vetra & Son (the only ones thereabouts), with a turning-basin at the upper end, would cost about $10,000; and to give the channel such protection as to make it probably permanent would cost $15,000 or $20,000 more, bringing the total up to $25,000 or $30,000.

Two maps will be sent forward in a few days; one lately made by Mr. Parsons, on a scale of one inch to 200 feet, and one furnished from the office of the United States Coast and Geodetic Survey, made in 1856, scale $\frac{1}{40000}$.

Very respectfully, your obedient servant,

WM. P. CRAIGHILL,
Major of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. GEORGE W. PARSONS, ASSISTANT ENGINEER.

SALISBURY, MD., *November* 10, 1880.

COLONEL: I have the honor to submit the following report of an examination of the throughfare between Deal's and Little Deal's Islands, together with a map of a survey of the same, made in accordance with your instructions of 28th of July.

The water passage separating the two islands, called the Lower Thoroughfare, to distinguish it from Upper, or Law's Thoroughfare, separating Deal's Island from the mainland, extends from Tangier Sound on the west, through to Manokin River on the east. It is 3,000 feet wide at its western terminus, narrowing to a width of 600 feet opposite Daniel's store; thence it has a variable and greater width until towards its eastern terminus, where it narrows again to a little over 600 feet, thence widening rapidly into Manokin River.

From Tangier Sound a channel or pocket extends from the 7-foot curve, with an average width of 450 feet, up into the thoroughfare about 1,200 feet, terminating at a depth of 4½ feet upon a bar dividing it from the south channel. This south channel, with an average depth of 4 feet and width of 260 feet, extends from the 7-foot curve up to and a short distance beyond Daniel's Wharf. Beyond this point the depth of water is almost uniform, averaging 2½ feet at its greatest depth, until it reaches the narrowest point towards the eastern terminus, where a channel begins, 100 feet wide, 5 feet deep, gradually widening and deepening until it reaches the 7-foot curve in a branch of the channel of Manokin River lying between Piney Island and Little Deal's Island.

This survey was made from the 7-foot curve in Tangier Sound to the 7-foot curve in Manokin River, as shown upon the map.

The thoroughfare is navigable between the narrow points described for smaller craft only, which pass through it upon higher stages of the tide from the sound to the river.

Deal's Island lies southwest of Somerset County, Maryland. It is 3 miles long, 1½ miles wide. It contains a population of 1,200 inhabitants, three churches, three schools, nine stores selling about $175,000 of merchandise annually. Most of its area is in cultivation, the soil being very productive, excellently adapted to fruits and vegetables, early varieties of which are grown ten days earlier than upon the main land. Culture of these crops would be profitable and important but for the distance to quick transportation. Marketed at present by uncertain sailing craft, the business is a precarious one. The principal occupation is taking oysters, which is carried on by 22 schooners, 43 sloops, 72 licensed canoes. Many thousand bushels are taken from the waters of Tangier Sound, and sold to Baltimore and Northern markets.

Little Deal's Island is, for the most part, a low-lying marsh, but little elevated above high-water mark. Three families live upon and cultivate the upland, and one store is situated upon the northeast corner of the island.

Along the west coast of these islands no harbors exist other than the two thoroughfares mentioned, these being available only for smaller craft. Schooners and sloops, having no protection from westward storms, are frequently beached and sometimes wrecked by sudden gales.

A channel and turning-basin in Lower Thoroughfare would afford a much needed harbor for oyster and other vessels, furnishing also a sheltered site for wharves, at which steamers could land, to the great convenience of merchants, shippers of produce, and travelers. To dredge a channel 100 feet wide, 7 feet deep at low-water, from the 7-foot curve in Tangiers Sound, following the pocket or north channel as shown, up to and along Daniel's wharf, to a point opposite Vetra & Son's wharf, with a turning-basin at its terminus, would cost $10,300. Such a channel would have to be protected against the shifting sands covering the muddy and clayey bottom near its proposed mouth, by a substantial dike of riprap, or other sufficient construction to render the improvement permanent. I estimate the cost of this dike at $15,000 to $19,000, additional, according to the character of the work.

The effect of such an improvement, besides protection to vessels at present engaged in oystering, would doubtless be to increase the number of vessels so employed, and also add materially to the production of the land, to the sales of merchandise, and in these ways to the benefit of commerce.

These islands are in the collection district of Crisfield, but I have not been able to ascertain from that point the entire number of licensed craft belonging to their inhabitants.

Very respectfully, your obedient servant,

GEO. W. PARSONS.

Col. WM. P. CRAIGHILL,
Major of Engineers, U. S. A.

The first appropriation for this locality was made March 3, 1881, $5,000. Proposals for work were called for May 10, 1881, and a contract has been made with Mr. D. Constantine, of Baltimore, the price of excavation and redeposit to be 27 cents per cubic yard, measured in place.

The excavation is required to be from a depth of 6 feet in the mouth of Lower Thoroughfare, extending a distance of 2,630 feet to a point opposite Daniel's wharf. The width is to be 100 feet, and there is to be a turning-basin at the upper end of the channel 200 feet square. The depth of the whole dredging is to be 6 feet at mean low-water. The amount of material to be excavated is about 20,000 cubic yards. The material consists of sand, soft mud, and shells. The depth of cutting varies from 0.3 foot to 3.2 feet.

The excavated material is to be deposited along the shores upon either side of the Thoroughfare, in localities provided by the contractor, to be approved by the United States Engineer, and without any expense to the United States, on any account whatever, but not nearer to the channel than 75 feet; or it may be towed and dumped in Tangier Sound in not less than 15 feet of water.

Money statement.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount available	5,000 00
Amount (estimated) required for the completion of existing project	5,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	5,000 00

Abstract of proposals for dredging at Lower Thoroughfare, Deal's Island, Maryland, opened at 11 o'clock a. m., June 15, 1881.

No.	Name.	Residence.	Time.		Price per cubic yard.	Remarks.
			Commence.	Complete.		
1	G. H. Ferris	Baltimore	April 1, 1882	July 1, 1882	$0 35	Measured in scows.
2	D. Constantine	do		June 30, 1882	24 27	Measured in scows. Measured in place.

Contract with D. Constantine.

G 14.

IMPROVEMENT OF BROAD CREEK FROM ITS MOUTH TO LAUREL, DELAWARE.

After a survey of this creek, in obedience to the direction of Congress, it was estimated that to make a channel by dredging, 7 feet in depth, at mean low-water, and 60 feet in width, would cost $46,500, and this sum must be increased to $60,000 if contraction of the water-way were attempted, by wing-dams and training-walls. Congress made an appropriation of $5,000 June 14, 1880.

It was determined to apply this sum to the excavation of a channel 20 feet wide, 4 feet deep at mean low-water; extending from the railroad bridge at Laurel to a point below Big Mills, a distance of 5,373 feet, following the south side of the proposed channel. The specifications stated that the material to be excavated consisted of mud, sand, and sawdust, in varing proportions, with an occasional buried tree of small size, the depth of cutting varying from 2 to 3½ feet. The rise of tide is about 3 feet. The material excavated was required to be deposited on one or both banks of the channel, as directed by the engineer in charge, 10 feet inside the growth of "cripples" or, where no cripples existed, not nearer either side of the channel than 20 feet. All sites for the deposition of material were to be procured by the contractor, without expense to the United States.

The work was twice advertised, but the bids received were too high and were rejected. The long and severe winter coming on, nothing was done until after the grant of another appropriation by Congress of $10,000, March 3, 1881. The work was again advertised, the channel to be of larger dimensions, proportioned to the greater amount of available funds. This excavation was proposed to be 32 feet wide, 6 feet deep at mean low-water, extending from the bridge at Laurel 6,500 feet down stream on the south side. Bids were duly received. That of the lowest bidder was reasonable in price; but after investigation, which took some time, he was found to be not capable of doing the work, or, to use the term of the law, he was not "responsible."

It was accordingly recommended to the Chief of Engineers to award the contract to the next lowest bidder, who was known to be responsible and capable. This recommendation was approved, and the work will be at once proceeded with.

For the purpose of having reliable commercial statistics, a letter was written to Mr. A. J. Horsey, an influential and active citizen of Laurel.

The following extracts contain information furnished by him and other citizens:

> The country fed by Broad Creek extends east from Lewisville 20 miles, with an average width of 15 miles, aggregating 300 square miles.
>
> Population of town of Laurel, 1,500; population of territory adjacent to and fed by Broad Creek, 8,500.
>
> There are thirty-one water mills and twenty-four steam mills in the territory seeking an outlet for their products through Broad Creek.
>
> The average yearly shipment of fruit from the vicinity of Broad Creek is as follows: of peaches, apples, and pears, 150,000 baskets; of berries, 2,048,000 quarts; of potatoes, 1,000 barrels, and 28,000 melons.
>
> There are thirty-three schooners and sloops, with an aggregate tonnage of 5,438 tons.
>
> Imports of merchandise in the town of Laurel and adjacent territory, $500,000; of fertilizers, $45,000; of lime, bricks, &c., $5,000; of coal, $2,000; total $552,000. This amount, particularly the item of merchandise, was nearly or quite double 10 years ago.

The exports from the town of Laurel and surrounding country, the exports of which have sought and will, if proper facilities are afforded, again seek an outlet by the waters of Broad Creek, are as follows: 120,000 bushels grain, 16,000,000 feet lumber, 10,000 cords wood, 200,000 dozen eggs, and 100,000 pounds of poultry.

The estimates as to grain, lumber, wood, and bark are based upon the trade of this place from five to ten years back; since that time, both the exports and imports of grain, wood, lumber, and general merchandise have fallen off one-third in consequence of the obstruction to our navigation, and the need of cheap transportation, the high and exorbitant rate upon the railroad amounting in many of our productions to almost a prohibition. We are confident, if the navigation of Broad Creek was so improved as to admit of vessels of a light draught of water, viz, 8 or 9 feet at high-water, to come up to the wharves in the town of Laurel, both the exports and imports from this place and surrounding country would be more than double what they are at this time, and will exceed our higest estimate, or what they ever have been by at least one-third.

Further, many new enterprises and industrial pursuits would spring up, such as the oyster trade; packing-houses would be established, also phosphate factories and lime-kilns, and ship-building, which was was at one time carried on extensively at this place, but has now become nearly abandoned in consequence of the deficiency in navigation, and the difficulty in getting vessels out after they are built, would be again revived, all of which would furnish employment for a large number of laboring men, women, and children; all classes of trade would receive a new impetus, and all the citizens of this town and surrounding country would be much benefited.

As you will discover from the above report, we have quite a number of schooners and sloops belonging on Broad Creek, drawing from 5 to 9 feet of water; many of them have to go from home to find employment, but if our navigation was improved, as above indicated, and cheap transportation afforded, our export and import trade would be so increased as to enable the greater portion of them to trade from home and find sufficient employment.

You will also discover from the annexed reports that there are located within the territory adjacent to Broad Creek fifty-five saw or lumber mills, thirty-one water and twenty-four steam, the products of which formerly did, and would again, return and seek transportation by the waters of Broad Creek if our navigation was improved and cheap transportation and other inducements offered; the products of some of said mills have within the last few years been directed in other channels for the want of facilities for transportation at fair and reasonable rates.

Money statement.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$15,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		89 58
July 1, 1881, amount available		14,910 42
Amount (estimated) required for completion of existing project		45,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		10,000 00

Abstract of proposals for dredging Broad Creek, Delaware, opened at 1 p. m. November 4, 1880.

No.	Name.	Residence.	Time.		Price per cubic yard.	Remarks.
			Commence.	Complete.		
1	Daniel Constantine.	Baltimore	March 1, 1881	July 1, 1881	$0 27 32½	Measured in scows. Measured in excavation (place).

Rejected; too high.

Abstract of proposals for dredging Broad Creek, Delaware, opened at 1 *p. m. November* 30 1880.

No.	Name.	Residence.	Time.		Price per cubic yard.	Remarks.
			Commence.	Complete.		
1	Geo. W. Parsons.	Salisbury, Md.	Feb. 1, 1881	Aug. 1, 1881	$0 30	Measured in place.
2	Daniel Constantine.	Baltimore.....	....	June 30, 1881	27 31½	Measured in scows. Measured in place.

Rejected; too high.

Abstract of proposals for dredging Broad Creek, Delaware, opened at 11.30 *a. m. June* 15, 1881.

No.	Name and residence.	Time.		Price per cubic yard.	Remarks.
		Commence.	Complete.		
1	George W. Parsons, Salisbury, Md.	10 days from completion of contract (on Wicomico.)	In 9 months ..	$0 28¼ 25¼	Measured in scows. Measured in place.
2	G. H. Ferris, Baltimore.	January 1, 1882..	July 1, 1882	58	Measured in buckets.
3	Daniel Constantine, Baltimore.	....	June 30, 1882....	27	Measured in place.
4	Campbell & Phillips, Wilmington, Del.	....	60 days from award of contract.	20	To scour away material by means of an adjustable floating dam; provided the work is awarded to them on their personal bond.

Contract with George W. Parsons.

REPORT OF MR. GEO. W. PARSONS, ASSISTANT ENGINEER.

SALISBURY, MD., *September* 14, 1880.

COLONEL: I submit the following report of a reconnoissance of Broad Creek, Delaware, made in compliance with your instructions of July 22.

In the present condition of this stream, all produce shipped by water from the town of Laurel is transported in shallow draught lighters from the wharves at and near the railroad bridge to Lewisville, a small village 3 miles below the present anchorage for vessels. These lighters are able to navigate the first mile of this distance only at high-water. Even at this stage of tide great difficulty is experienced by grounding or sinking of the lighters, often resulting in damage to or loss of grain and other produce compelled to seek this outlet. The trade of Laurel is considerable and would naturally increase if good navigation for lighters could be secured.

With the present appropriation of $5,000 a channel 20 feet wide and 4 feet deep, at mean low-water, can be excavated from the railroad bridge to the first angle below "Big Mills," a distance of 5,373 feet, beyond which lighterage is unobstructed.

In the absence of retaining-dikes the dredged material can, by properly-constructed machinery, be deposited within the growth of cripples upon either side of the stream a sufficient distance from the edge of the channel to effectually prevent its being carried by freshets into the stream again.

Should subsequent appropriations be made, this supplementary channel can be easily widened and deepened to accommodate vessels.

The proposed channel can be finished within the appropriation, and practical knowledge of the benefits secured by a like improvement to a neighboring town similarly situated induces the belief that the result would be a valuable improvement to Laurel and vicinity.

Respectfully, your obedient servant,

GEO. W. PARSONS.

Lieut. Col. WM. P. CRAIGHILL,
Corps of Engineers.

G 15.

IMPROVEMENT OF THE WICOMICO RIVER BELOW SALISBURY, MARYLAND.

An appropriation of $5,000 was granted for this river June 14, 1880. Call for proposals for certain work was made by advertisement of July 22, 1880, on the following specifications:

> The portion of the river to be improved extends from the draw-bridge at Salisbury to a point about 1,840 feet below, including a turning basin between the wharves at the town, a through channel and redredging the area near the draw-bridge, all to a depth of 7 feet at mean low-water. Total amount of excavation measured *in situ* about 13,000 cubic yards.
>
> 1st. It is proposed to continue the channel, 7 feet deep at low-water, 65 feet wide on the bottom, from where it ended when the dredging ceased in January, 1880, up to a point opposite the lowest wharf upon the southeast side of the river.
>
> 2d. To dredge to 7 feet deep at low-water the whole area above this point and the draw-bridge within 20 feet of the wharves upon each side of the river.
>
> 3d. To dredge a turning basin 7 feet deep, 94 feet long, 67 feet wide, between and within 20 feet of the wharves upon each side of the southeast branch of the river.
>
> 4th. To dredge a channel through the draw-bridge, and redredge the area above the bridge, between the harbor line and wharf line, for 360 feet of its length, all to a depth of 7 feet at low-water.
>
> Any surplus funds unused in the above specified work may be expended, at the discretion of the Engineer, in redredging the channel at points hereafter to be determined within its length of 1½ miles below the town.
>
> The material to be excavated consists of mud, sand, and sawdust; the depth of cutting varies from 1½ to 2½ feet. The material opposite the retaining dikes will be deposited behind them at a distance of not less than 20 feet from their edge. The material between the wharves at the town and above the draw-bridge will be scowed and redeposited either behind the dikes, 20 feet from their edge, or behind the dredged bank upon the flats below the dikes, as may be preferred by the contractor, and all other material will be deposited upon or behind the dredged bank upon the flats.
>
> The tide rises about 3.2 feet.
>
> The location of the work is sheltered, and no time need be lost on account of high winds.

A contract was made with Mr. Geo. W. Parsons.

Work was commenced September 13, 1880, was suspended on account of ice, &c., December 9, 1880, was resumed February 25, 1881, and was completed June 17, 1881. The number of cubic yards removed was 15,721; of this 9,011 cubic yards were removed by means of the chute, and deposited behind the dike near the points dredged, for which the contractor was paid 22 cents per cubic yard measured in place.

Six thousand seven hundred and ten cubic yards were removed on scows and deposited behind the dikes, just below the entrance to Mr. Parsons' mill property, for which the contractor was paid 32 cents per cubic yard *in situ*.

The work under the contract commenced at a point 2,100 feet below the draw-bridge at Salisbury, and extended up to the said bridge.

A channel 65 feet in width, with a depth of 7 feet at low-water, was finished up to a point about 600 feet below the draw-bridge; from this point to the bridge the whole area between the wharves, with the exception of 20 feet along the wharf fronts, was excavated to a depth of 7 feet at low-water. The southeast branch was dredged to the same depth on to within 20 feet of the wharves, for a distance of 24 feet.

The point immediately below the end of the dike on the north side of the river was taken off, so as to relieve the great bend at that place.

There was no dredging done above the draw-bridge, as from examinations made it was found that there was the requisite depth.

Money statement.

July 1, 1880, amount available	$5,002 33	
Amount appropriated by act approved March 3, 1881	2,000 00	
		$7,002 33
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		4,965 21
July 1, 1881, amount available		2,037 12

Abstract of proposals for dredging Wicomico River, Maryland, opened at 1 p. m., August 17, 1880.

No.	Name.	Residence.	Price per cubic yard.	Remarks.
1	George W. Parsons	Salisbury, Md	$0 22 82	Chuted into place of deposit. Scowed away. Measurement in place.

Contract with George W. Parsons.

G 16.

REMOVAL OF OBSTRUCTIONS IN THE POKOMOKE RIVER, MARYLAND.

Operations on this river were closed April 6, 1880, according to the plan detailed in full in the Annual Reports for 1879 and 1880. There was no appropriation in 1880, nor at the session of Congress which closed March 3, 1881. Consequently nothing was done in the fiscal year ending June 30, 1881.

Money statement.

July 1, 1880, amount available	$134 29
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	134 29

G 17.

IMPROVEMENT OF ONANCOCK HARBOR, VIRGINIA.

At the close of the year ending June 30, 1880, the contractor was dredging a channel across the bar at the entrance of the creek. He made an excavation 100 feet in width and 8 feet deep at mean low-water, removing 11,567 cubic yards. The least depth on the place cut had previously been 4½ feet at low-water.

A new appropriation of $5,000 was made June 14, 1880. After due advertisement a contract was made on the following basis:

Locality.—1st. Under the following specifications it is proposed to excavate a channel 100 feet wide though the shoal above Wise's Point, between Lewis's wharf and Old wharf, from the 7-foot curve below, extending up to and along the 7-foot curve above, connecting the two curves as shown upon the map.

2d. To excavate a channel 100 feet wide from the end of the 7-foot curve at a point 800 feet below, up to and terminating at the steamboat wharf.

3d. To excavate a channel 80 feet wide, parallel to and 10 feet distant from the northwest front of the steamboat wharf.

4th. To excavate a channel 60 feet wide, parallel to and 10 feet distant from the front of the wharves, extending northeast from the steamboat wharf, terminating at the steam-mill wharf.

5th. To excavate a turning basin parallel with and 10 feet distant from a line joining the outside angles of the wharves running southeast from the steamboat wharf, 160 feet wide, when it leaves the channel, and 80 feet wide at its terminus opposite the upper end of the wharves.

All the dredging proposed is to a depth of 7 feet at mean low-water, and amounts to about 16,000 cubic yards. The appropriation available is $5,000, less engineering, superintendence, and contingencies.

Material.—The material to be removed consists of mud, fine sand, and a few shells.

Depth of Cutting.—The depth of cutting varies from 1.3 feet to 4.5 feet.

Tides.—The tides rise 1.9 feet.

Dumping.—The excavated material may be deposited behind bulkheads built by the citizens in tributary creeks and sheltered bends having a depth of 3 to 5 feet water, the locations to be approved by the Engineer in charge, or it may be towed and dumped in deep water beyond the bar at the mouth of the creek, but in all cases without expense to the United States on any account whatever.

The work of dredging on this creek was commenced March 8, and finished April 15, 1881, by the American Dredging Company, of Philadelphia, Pa. Total amount excavated, 20,297 cubic yards. A channel of 100 feet in width and 7 feet in depth at mean low-water was completed from Wise's Point to a point about 1,300 feet above. The material dredged from this area was deposited in a cove below Wise's Point in about 6 feet of water and about 450 feet from the channel. The total amount dumped at this point was about 4,000 cubic yards. The next place dredged commenced at a point about 1,100 feet below the steamboat wharf and extended up to the turning basin, a distance of about 900 feet. A turning basin of about 43,000 square feet in area was dredged to 7 feet in depth at mean low-water, and to within a distance of not less than 10 feet from the wharves.

A channel 60 feet in width, 7 feet in depth, and about 500 feet in length, was dredged from the upper corner of the steamboat wharf to Miles' saw-mill wharf. All this material, with the exception of a very small amount put on the wharves over behind the dike, was deposited in two coves opposite Bailey's Point, about 2 miles above the mouth of the creek.

Money statement.

July 1, 1880, amount available	$6,869 93
July 1,1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	6,425 70
July 1, 1880, amount available	444 23

Abstract of proposals for dredging harbor at Onancock, Va., opened at 1.30 *p. m. November* 4, 1880.

No.	Name.	Residence.	Time.		Price per cubic yard.	Remarks.
			Commence.	Complete.		
1	American Dredging Company.	Philadelphia	Feb. 1, 1881	Apr. 30, 1881	$0 20	Measured in scows.
2	Daniel Constantine.	Baltimore	Jan. 1, 1881	July 1, 1881	30	Measured in scows.

Contract with American Dredging Company.

INFORMATION AS TO THE COMMERCE OF ONANOCK, VA., FROM MR. G. W. JOY, DEPUTY COLLECTOR, RECEIVED THROUGH HON. J. L. THOMAS, COLLECTOR OF BALTIMORE.

In reply to yours of 2d June, I have to give you the following summary of shipments from Onancock Creek for the year 1880:

Sweet potatoes	bbls..	68,000
Irish potatoes	do...	23,000
Pease	do...	2,500
Radishes	do...	1,000
Oysters	do...	1,000
Peaches	boxes..	5,000
Strawberries	quarts..	100,000
Blackberries	baskets..	5,000
Lumber	feet..	1,000,000

A second saw-mill is now in course of erection, which will probably double the amount of lumber for the present year. Engaged in carrying this produce were two side-wheel steamers, tonnage 1,139.95 tons, and seventeen sail vessels, tonnage 528.61 tons; the steamers and nine of the larger vessels have a draught of 7 feet water, when loaded. The balance of the vessels draw from 3¼ to 5¼ feet loaded.

LIST OF VESSELS TRADING FROM ONANOCK CREEK, VA., AS REPORTED BY THE COLLECTOR AT THE PORT, AS FOLLOWS:

	Tons.
Schooner Four Sisters	33.91
Schooner Alice and Anna	49.25
Schooner Kate R. Waters	38.96
Schooner J. Calhoun Johnson	26.94
Schooner Philip Kirkwood	42.78
Schooner Robert J. Poulson	29.94
Schooner Wade	19.99
Schooner Geo. P. Keagle	42.96
Schooner Neptune	44.90
Schooner Wm. N. Finney	29.97
Schooner Wm. S. Rogers	29.69
Schooner Charles Sweaver	16.63
Schooner Shoo Fly	15.03
Steamer Anna Clark	8.66
Steamer Tangier	589.09
Steamer Helen	550.86

The above vessels are owned at this port, and are engaged in trading from this creek. The Onancock Mill Company generally charter from Crisfield or elsewhere. The vessels employed by them are not included in the above list; they keep one and sometimes two running.

G 18.

IMPROVEMENT OF JAMES RIVER BELOW RICHMOND, VIRGINA.

The results of the past year's work are as follows: A large number of loose bowlders were removed from the channel below Rockett's Reef; the channel of Goode's Rocks has been widened 50 feet, but is yet incomplete. Richmond Bar and two shoal places below have been dredged out, a large number of wing-dams have been built, and Dutch Gap Cut-off has been widened and deepened, and now has 18 feet depth at low tide. Channels about 200 feet by 18 feet at low-water have been made at Varina, Swan's Point, and Goose Hill Flats. There is now a depth in the channel of 19 feet at high-water from the sea to Warwick Bar, 5½ miles below the ship lock, and the removal of 60,000 cubic yards at Curl's Neck and Deep Bottom will increase this depth to 20 feet. From Warwick Bar to Richmond there are 17 feet at high tide. The details of work and results are fully given in the appended report of Mr. H. D. Whitcomb.

Money statement.

July 1, 1880, amount available	$88, 457 54	
Amount appropriated by act approved March 3, 1881	60, 000 00	
		$148, 457 54
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	56, 269 92	
July 1, 1881, outstanding liabilities	719 55	
		56, 989 47
July 1, 1881, amount available		91, 468 07
Amount (estimated) required for completion of existing project		130, 000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		130, 000 00

Abstract of proposals for widening and deepening the channel of James River, Va., opened at 12.5 *p. m., August* 10, 1880.

Name and residence.	Time.		Price per cubic yard.	Remarks.
	Commence.	Complete.		
G. H. Ferris, Baltimore, Md.	In accordance with the specifications.	In accordance with the specifications.	$0 23	Richmond and Warwick Bars.
			21	Varina Reach and Curle's Neck.
James Caler, Richmond, Va.	Immediately after finishing present contract.	As per specifications.	15	Varina Reach, 40,000 cubic yards.
			17	Curle's Neck, 40,000 cubic yards, more or less.
Frank Pidgeon, jr., 116 Wall street, New York.	Within 30 days....	Within the fiscal year.	1 50	Rocketts Reef to Chesapeake and Ohio Railroad wharves: dredgable material and bowlders up to ½ yard, all rock over ½ cubic yard, $14 per cubic yard.
			21	Richmond and Warwick Bars: will put half of this material ashore for 27 cents additional per cubic yard.
			90	Dutch Gap Cut-off.
			19	Varina Reach.
			19	Curle's Neck.
				Dredging and rehandling Warwick and Richmond bars, all to be shoveled, 55 cents per cubic yard; Rocketts to Chesapeake and Ohio Railroad, $1 per cubic yard.

Contract with G. H. Ferris for Richmond and Warwick bars.
Contract with James Caler for Varina Reach and Curle's Neck.
Proposals for work at Rocketts Reef and Dutch Gap, being too high, were rejected.

REPORT OF MR. H. D. WHITCOMB, ASSISTANT ENGINEER.

RICHMOND, VA., *June* 10, 1881.

COLONEL: I have the honor to submit the following report on the improvement of James River for the year ending with May 31, 1881.

At the date of the last annual report the general government had a day force employed in enlarging the channel through Rocketts Reef, and a contract with James Caler for deepening the channels through the three shoals below City Point was in course of execution; the channel through Harrison's Bar, the first of the three, having been completed. The city of Richmond was deepening Dutch Gap Cut-off to 18 feet at low-tide. The work at Rocketts Reef was suspended June 30, leaving a channel through it 90 feet between 12-foot curves and 50 feet between 15-foot curves at low-tide.

Work was resumed by the day force July 15, 1880, in cleaning out the channel between the reef and the Chesapeake and Ohio Railway wharves. A large number of loose bowlders and some rock in place were removed, amounting to about 300 cubic yards. September 8 this force removed to Goode's Rocks and has been employed there since that time, except in January, February, and March, in enlarging the channel at that point.

August 25, 1880, a contract was made with James Caler for dredging the shoals at Varina and Curle's Neck; and on the 26th, with G. H. Ferris for dredging on Richmond and Warwick bars.

Mr. Ferris began work September 14 and completed his contract November 30. Mr. Caler finished the channel through Goose Hill Flats about the same time and removed to Swan's Point Shoal. He also employed a rented dredge in December at Varina.

The city of Richmond completed the enlargement at Dutch Gap December 4 and then employed two dredges assisting the work at Goode's Rocks until the 29th, when the river closed with ice, and all work was suspended until late in February, 1881. A day force was also employed, using the city pile-driver in building timber wing-dams; another day force was employed in making brush mats, which were used in protecting the ends of the wing-dams against scour, and in other places where they could be useful. These mats were 40 by 20 by 3 feet, and were loaded and sunk with stone, gravel, and in some cases with sand alone. In protecting the dams one or more were placed immediately above and below the dams, projecting 10 feet outside their ends, and have proved to be so far a perfect protection against undermining. Mr. Caler resumed work at Swan's Point in the latter part of February and completed hi contract of 1879 on the 8th of March, 1881. He then moved his dredges to Varina and completed the channel at that point on May 30, 1881. He is now at work at Curle's Neck.

The day force resumed work at Goode's Rocks in April, 1881, and expect to complete the enlargement of that channel in two or three months. It is being carried to 15 feet depth at low-tide. The timber force, with the pile driver, have also been engaged since April in building wing-dams between Rocketts Reef and the lower end of Warwick Bar.

The results of the past year's work are as follows:

A large number of loose bowlders were removed from the channel below Rocketts Reef. The channel at Goode's Rocks has been widened 50 feet, but is yet incomplete. Richmond Bar and two shoal places below have been dredged out; a large number of wing-dams have been built, and Dutch Gap Cut-off has been widened and deepened, and now has 18 feet depth at low-tide Channels about 200 feet by 18 feet at low-tide have been made at Varina, Swan's Point, and Goose Hill Flats.

There is at this date a depth in channel of 19 feet at high-tide from the sea to Warwick Bar, 5¼ miles below the ship lock; and the removal of 60,000 cubic yards at Curle's Neck and Deep Bottom will increase this depth to 20 feet. From Warwick Bar to Richmond there are 17 feet at high-tide.

A chart of the river for 6¼ miles below Richmond has been made, showing the soundings taken in May, 1881.

This chart, when compared with that of May, 1880, shows marked improvement in the width and depth of the channel, especially in the sand shoals, where the width of the river has been contracted. This mode of improvement on this part of the river is no longer an experiment; the results appear to be a permanent progressive improvement. On the other hand there has been some shoaling below all the dams for about 1 mile in length, doubtless due to the scour from above; and whether this is merely a temporary shoaling or not, I think the system of contraction should be continued over this mile to Falling Creek, 6¼ miles from the city, below which point, for several miles, there is an abundant depth of water, in a channel naturaly contracted.

The river has been very low during the year. There was but one freshet worth noting, which occurred in February, 1881, a rise of 9¼ feet above mean high-tide. The results from the scour of this freshet were satisfactory, but we have not had enough high-water yet to warrant the assertion that the lines of contraction are sufficiently close to maintain a depth of 15 feet at low-tide. So far as we can judge, the lines are nearly right. The improvement of the river in the past year is shown practically by the action of the Old Dominion Steamship Company, who have recently established a regular hour for the departure of their steamers, instead of, as heretofore, leaving at high-tide. After the flood of 1870 these steamers could not come to the city for several months, then for a while only at high-tide. For several years parts of their cargoes were lightered; this was rendered unnecessary a year or two since, and now they arrive and depart regardless of the state of the tide.

With this report is submitted a map of the river from Mayo's Bridge to Falling Creek as it was found by the United States Coast Survey in 1853, and as it is at present. The depths are given at low-tide in both cases. The lines of contraction are shown and the contour of 12 feet at low-tide is shown by dotted lines. An examination will show that in 1853 a depth of only 7 feet at low-tide (10½ feet at high tide) existed on Rocketts Reef and Richmond Bar, and that the contour of 12 feet existed only in detached spots above Richmond Bar. This contour is now continuous, and a contour of 15 feet at low-tide would approach continuity. The contraction of the width of surface which has aided so much in this improvement, and which certainly maintains it, was not carried to the present lines at one move. There have been several extensions of the wing-dams in places, and five, I think, on Richmond Bar. This shoal 2¼ miles below Rocketts was of sand; the width of river was about 1,200 feet. The greatest depth on the crest at mean low-tide was 7 feet. The channel was tortuous. A channel was dredged through it three times, but after a few freshets, not over 2 years in time, the bar was restored to the same depth and cross-section. In 1873-'74 a longitudinal dike was built reducing the width to 800 feet, and the channel again dredged; in 1875 the bar had again shoaled to $9\frac{2}{10}$ feet, with a sectional area of 5,799 square feet. This showed a gain in depth of over 2 feet. Wing-dams were then thrown out on both sides of the river, and added to from time to time, until now the width between the dams, which are carried to level of high-tide, is 475 feet. The depth in channel on the crest is now $15\frac{2}{10}$ feet, and the bar exists no longer. The sectional area on this crest has remained very constant, following the several contractions.

	Square feet.
In 1875, width 800 feet, greatest depth 9.2, the area was	5,799
In 1878, width 588 feet, greatest depth 11.8, the area was	5,840
In 1880, width 475 feet, after dredging 16, the area was	5,785
In 1881, width 475 feet, after freshet 15.2, the area was	5,856

The action of the freshet was to enlarge the section and to round out the channel as left by the dredges. A similar constancy in area has been found to obtain elsewhere under similar treatment so much so that in planning for a greater channel depth it is assumed that the bottom will be scoured so as to produce this area when a contraction is made. I feel confident that all the shoals in the lower part of the river, caused or maintained by sediment now transported by the river, can be permanently removed by contracting the width of river at those points. All the shoals are at points where the river is more than the average width in the vicinity. The shoals below City Point are apparently, so far as I know, in an older deposit, where dredging is needed, but even then the improvement would be hastened and made more permanent by properly located dikes.

Cubic yards of material removed by the United States in 1880-'81.

Locality.	Solid rock and bowlders.	Soft and decomposed rock.	Indurated earth.	Sand and mud.	Total.
	Cub. yds.	*Cub. yds.*	*Cub. yds.*	*Cub. yds.*	*Cub. yds.*
Ship lock to Rocketts Reef	129			540	669
Rocketts Reef	273				273
Rocketts Reef to Chesapeake and Ohio Railway wharves.	298	625		625	1,548
Goode's Rocks	1,257	4,000		10,576	15,833
Richmond and Warwick bars				47,212	47,212
Varina Shoal				47,970	47,970
Swan's Point Shoal				7,622	7,622
Goose Hill Flats			69,297		69,297
Total	1,957	4,625	69,297	114,545	190,424

	Linear feet.
Timber wing-dams constructed above Warwick Bar	3,963
Timber wing-dams constructed at Varina	500
Brush mats for protection to wing-dams	50

Cubic yards of material removed by parties other than the United States.

Parties.	Solid rock and bowlders.	Soft and decomposed rock.	Indurated earth.	Sand and mud.	Total.
	Cub. yds.	*Cub. yds.*	*Cub. yds.*	*Cub. yds.*	*Cub. yds.*
City of Richmond	92	8,080	32,890	12,505	53,567
Railroad and Steamship companies	50			4,330	4,380
Total	142	8,080	32,890	16,735	57,847

Total cubic yards removed by all parties, 248,271.

The deepening and removal of slides at Dutch Gap Cut-off, included above, required the excavation of 32,890 cubic yards of indurated earth, all of which was done at the expense of the city of Richmond.

In reply to the specific inquiries in Circular No. 18 from the office of the Chief of Engineers, dated December 9, 1880, I submit—

1st. Previous to 1870 the first 4 miles below Richmond were shallow, except in short reaches, the general depth being 8½ feet in channel at low-tide. The reef at Rocketts and the sand shoal known as Richmond Bar had but 7 feet. Warwick Bar, 5 miles below the city, had 13 feet. The channel near Richmond was tortuous, and obstructed with a large number of rocks, mostly bowlders, besides the ledges at Rocketts and Goode's.

The Dutch Gap Cut-off, which now saves 5¼ miles of difficult navigation, was not open. After the flood of 1870 but little over 6¼ feet could be carried over Richmond Bar at low-tide.

2d. The original project for improvement was for 18 feet at high-tide, with a channel width of 180 feet from the Richmond Dock to below Harrison's Bar.

The mean rise and fall of tide is about 3¼ feet, and about 3 feet at neap-tides, and the excavations in rock were to be carried to 15 feet depth at low-tide. In removing sand shoals, where the operation is aided by wing-dams, the intention has been to so contract that the scour would produce a channel of the same depth. The only intentional change in plan has been to make the channel below Warwick Bar, *i. e.*, from 5 miles below Richmond, 200 feet by 18 feet at low-tide instead of high-tide, which made it necessary to include 2 shoals below and 2 above Harrison's Bar, which were not included in the original estimates.

3d. The amount expended by the general government up to June 30, 1880, was $441,542.46, and by the city of Richmond was $356,710.

4th. On June 30, 1880, there was a depth of 17 feet at high-tide from the sea to Warwick Bar, and of 16 feet from Warwick Bar to the wharves at Rocketts.

5th. The amount expended by the United States in the year ending June 30, 1881, will have been $56,989.47, and by the city of Richmond $26,301.

The results of the year's work are a depth in channel of 20 feet at high-tide, from the sea to City Point, 19 feet from thence to Warwick Bar, and 17 feet from the latter point to the Rocketts wharves. There has been also an improvement in the width and direction of channel at several places, but the channel is still narrower than it should be in other places, *e. g.*, at Rocketts Reef.

6th. The whole amount needed to complete the original scheme (which, as appears in the estimate given below, is $128,684) could be profitably expended in the year ending June 30, 1882. The means appropriated, after paying for existing contracts, should, in my judgment, be applied, 1st, to widening and deepening the channel in the hard material near Richmond, and in completing the system of contraction as now designed, not including, however, the permanent work mentioned in the estimate; and, 2d, to further improve the channel between Varina and City Point, and between Warwick Bar and Dutch Gap.

7th. The permanence of the improvement through shoals of alluvium can only be maintained by permanently contracting the river at those points. The contraction for the most part has heretofore been made with timber structures, which are not permanent. We are, it is true, revetting these structures with material dredged from the channel, much of which is suitable for that purpose and permanent, but a larger amount than we are likely to get from the river under the present scheme will be required to permanently protect the wing-dams already built. It is also probable that for some considerable distances, especially where the current changes from one side to the other, the ends of the wing-dams on the same side must be connected at (say) the level of low-tide. In a work which is largely experimental to me, it is difficult to estimate the amount needed to make the work permanent, but I think that $85,000, in addition to the amount estimated on the present scheme, will suffice. If the channel near Richmond is widened, as suggested elsewhere, this would furnish most of the material needed and diminish the combined cost of the two works as estimated. My estimate for permanent improvement on the present plan is $213,684.

It may not be amiss, however, to call your attention to the fact that the last Congress directed an examination of the river to be made, with a view to ascertain the practicability and cost of deepening the channel to 25 feet at full tide.

If a further deepening is undertaken, the lines of contraction will be brought nearer together, and the work on any connecting dikes, or those parallel to the current, will be in great measure lost. I may also be pardoned for suggesting that the repairs to timber dikes from time to time may be less than the interest on the cost of permanent work would be.

TIDES.

During the year, 553 high-tides and 543 low-tides were observed, from which the following means, referred to one assumed zero, are obtained, viz:

	Feet.
Mean high-tide above zero	3.382
Mean low-tide below zero	0.323

	Feet.
Mean rise and fall of tides	3.705
Highest rise above zero—freshet in February, 1881	12.95
Lowest low-tide below zero, November 23, 1880	1.95
Mean of 2,511 high-tides observed since September, 1875, above zero	3.403
Mean of 2,501 low-tides observed since September, 1875, below zero	0.207
Mean rise and fall	3.610
Highest rise of river observed in that period, November, 1877	28.80
Lowest fall of tide observed below zero	2.40

Further observations are needed to determine whether the plane of low-tide has been permanently lowered by deepening the channel below Richmond. The height of low-tide, much more than that of high-tide, depends upon the amount of discharge from above the falls. The river has been very low for three successive years, and this may account for all, as it does account for a part of the lowering of the plane of low-tide, in which 1875 was at one zero. The plane of 1881 is .3 foot below that, but is actually $\frac{6}{100}$ higher than the plane of 1880.

During the past year Mr. C. P. E. Burgwyn, who is assisting on this work, has prepared a statement of the volume of the river between high and low tide for each 1,000 feet in length in a distance of 7 miles below the city, and will continue the work at wider intervals to some point lower down, to ascertain, if possible, the relation (which I am sure exists) between the sectional area at any given point and the volume of tidal water which passes it. If this relation can be obtained with tolerable accuracy, the lines of contraction, to produce any desired depth of channel, could be closely calculated. This matter is not sufficiently advanced for presentation at this time.

COST OF COMPLETING THE WORK.

I have added to the usual estimate the probable cost of widening the channel between Richmond Dock and Rocketts Reef, to an average of 3.0 feet, which would still leave 50 feet on each side to be excavated by owners of wharf property. The quantities of solid rock are approximate, as they could only be ascertained in advance by frequent borings. More than two-thirds of the rock is in the first 600 feet below the dock. In this distance, however, are the wharves of the Old Dominion Steamship Company, whose ships are larger than any others now coming to this port, and also a part of the wharves of the Richmond and Danville Railroad Company, whose business is rapidly increasing.

ESTIMATE.

Channel 180 feet by 15 feet at low-tide:		
16,000 cubic yards dredging soft rock, at 40 cents	$6,400	
800 cubic yards solid rock, at $5	4,000	
		$10,400
Through Rocketts Reef:		
3,000 cubic yards of rock, soft and hard, at $5		15,000
Rocketts Reef to Goode's Rocks:		
40,000 cubic yards dredging soft rock, &c., at 40 cents	$16,000	
500 cubic yards solid rock, at $5	2,500	
500 linear feet timber wing-dam, at $1.50	750	
1,000 linear feet of connecting dikes, at $3.50	3,500	
		22,750
Goode's Rocks to Richmond Bar:		
5,000 cubic yards dredging soft rock, at 40 cents	$2,000	
1,500 cubic yards solid rock, at $5	7,500	
400 linear feet timber wing-dams, at $1.50	600	
		10,100
Richmond Bar to Falling Creek:		
50,000 cubic yards dredging sand, at 20 cents	$10,000	
3,000 linear feet timber wing-dams, at $1.50	4,500	
3,000 linear feet connecting dikes, at $5.50	16,500	
		31,000
Kingsland's Reach Channel, 18 feet at low-tide:		
15,000 cubic yards in repair of levee, at 18 cents	$2,700	
800 linear feet sheet-pile dikes and filling, at $4.50	3,600	
840 linear feet of crib wing-dams, at $4	3,360	
630 linear feet sheet-pile wing-dams, at $2.50	1,575	
10,000 cubic yards dredging in sand, at 20 cents	2,000	
		13,235

Varina or Aikins:		
1,000 linear feet of timber wing-dams, at $2.50		$2,500
Shoal above Deep Bottom:		
20,000 cubic yards dredging in mud and sand, at 20 cents		4,000
Curle's Neck Shoal:		
40,000 cubic yards dredging in mud and sand, at 20 cents		8,000
Total		116,985
Add for contingencies		11,699
Total for present scheme		128,684
To make the work permanent:		
Additional revetment to timber-dams above Warwick	$21,000	
3,000 linear feet of dike of mats and stone at Varina	24,000	
2,000 linear feet of dike of mats and stone at Deep Bottom	16,000	
3,000 linear feet of dike of mats and stone at Curle's Neck	24,000	
		85,000
For widening channel at Richmond to 370 feet:		
98,000 cubic yards dredging sand and soft rock, at 35 cents	$54,300	
13,100 cubic yards solid rock, at $5	65,500	
		119,800
Total		333,484

COMMERCIAL STATISTICS.

The following letter from the collector's office has been received:

CUSTOM-HOUSE, RICHMOMD, VA.,
Collector's Office, June 10, 1881.

SIR: In compliance with your request, I inclose a statement of duties on imports received, number and tonnage of vessels engaged in the foreign and coastwise trade, and the value of imports and exports. The statement covers a period from June 1, 1880, to May 31, 1881. In addition to the vessels above-named, many enter and clear coastwise of which we have no record, their cargoes being of such a kind as not to necessitate the entry and clearance of the vessels at this office.

Respectfully,

ARTHUR A. SPITZER,
Deputy Collector.

MR. H. D. WHITCOMB,
Assistant Engineer.

The statement inclosed was as follows:

Vessels engaged in foreign trade:	
Entered, vessels	36
Tonnage	13,286
Cleared, vessels	118
Tonnage	38,961
Vessels engaged in the coasting trade:	
Entered, vessels	946
Tonnage	784,516
Cleared, vessels	604
Tonnage	540,663
Value of imports	$103,961
Value of exports	2,127 316

STATEMENT OF THE HARBOR MASTER.

The number and class of vessels and amount of tonnage arrived at the port of Richmond during the year ending with May 31, 1881, is as follows:

	Vessels.	Tonnage.
Sea-going steamers	306	450,000
Sailing vessels, viz:		
Barks and ships	59	22,000
Brigs	51	13,000
Schooners	840	197,000
Total	1,256	682,000

The above does not include river steamers, tug-boats, nor river schooners, sloops, nor any inside commerce whatever.

R. H. STYLL,
Harbor Master.

There are several river steamers, one of which, carrying passengers and freights, runs tri-weekly between Norfolk and Richmond; another makes two weekly trips between Richmond and the Chickahominy River; other river steamers are for freights alone and have no regular schedule.

The Old Dominion Steamship Company runs a tri-weekly line of steamships from Richmond to New York; two of them are over 2,000 tons register.

The Clyde line has a tri-weekly line of screw ships between this port and Philadelphia, and a screw ship to Baltimore in addition.

The city of Richmond has aided the work, in addition to that mentioned above, by furnishing dredges, tugs, a pile-driver, and scows to the general government, free of other charge than the actual cost of repairs. Mr. C. P. E Burgwyn and Mr. Milnor Paret have assisted me as assistant engineers. Mr. C. L. Kalmbach has had charge of the rock excavation, and Captain Thomas Cunningham of other work on the improvement, except that part under contract. I have only commendation for the manner in which these gentlemen and the persons employed under them have performed their several duties.

The work is in the collection district of Richmond, Petersburg, and Norfolk.

Very respectfully, your obedient servant,

H. D. WHITCOMB,
Assistant Engineer.

Col. WM. P. CRAIGHILL,
Corps of Engineers.

G 19.

IMPROVEMENT OF APPOMATTOX RIVER, VIRGINIA.

The death of Mr. H. D. Bird, who for more than ten years has been the local engineer for this improvement, is a matter for real regret. He has discharged his duties with zeal, ability, and uniform courtesy.

The following summary of work done in each month of the fiscal year, and of the expenditures made, will indicate the condition of affairs on the river.

July, 1880.—Twenty-six mats, made of brush and poles, each 23 feet long, 12 feet wide, and 2 feet thick. Twenty mats put in along the work near upper end of Puddledock channel, and closing the old channel; 186 yards of riprap at same place.

Sixty-seven round piles driven in training wall between wing-dams 21 and 22.

Proposals for dredging called for by advertisement of July 15, $731.87.

August, 1880.—Five mats and 94 yards of riprap put in at dams 23 and 24; 593 linear feet of training-wall completed between dams A, B, and C, and below 22.

Dredging commenced under contract with Mr. Ferris, at 28 cents per cubic yard for excavation and redeposit, material to be placed behind training-walls or between dams, where it cannot get back into channel.

Amount excavated, 2,533 yards, near upper end of Puddledock, and up to dam 21, $1,330.39.

September, 1880.—Dredging 7,206 yards; in all, 9,739, at various points from closure up to the city. About 20 feet taken off each of dams 2, 3, and 4 south, which were found to be too long.

Repairs made to Lieutenant Run training-wall near the city, $3,571.64.

October, 1880.—Repairs of wattled dams. Old pile-work, built years ago by the city, removed near Joiner's Spring; 138 round piles and 205 linear feet sheet-piling driven in wall between dams 22, 23, and 24.

The city did some dredging within the city limits. Expenses of United States, $3,521.75.

November, 1880.—Training-wall from dam 22 to 24 completed. Brush dam, 250 feet long, from end of Lieutenant Run training-wall to island bordering Stein's upper cut, strengthened. The city still engaged in dredging within the city limits and building four wing-dams on side opposite Petersburg. Expenses of United States, $1,698.22.

December, 1880.—All operations suspended. Care of property and soundings and examinations in river, $7[illegible].24.

January, 1881.—Some damage to timber-works caused by ice and freshets, but an examination of the river showed it to be in better condition than ever before at this season of the year. Proposals for more dredging called for, $405.40.

February, 1881.—Contract made with Mr. Ferris for additional dredging, at 28 cents per cubic yard. Repairs of breach made by ice at closing work of old channel near upper end of Puddledock. Fifty-two round piles driven and 112 linear feet at sheet; 10 mats placed, loaded with gravel and sand. Brush for mats cut, numerous soundings made in the river. $566.77.

March, 1881.—One hundred and sixty-nine feet sheet-piling driven, 13 mats placed, $1,037.81.

April, 1881.—Seven thousand and sixty-four yards dredged. Brush cut for 10 mats. Tow-boat advertised for without success. $1.027.90.

May, 1881.—Seven thousand nine hundred and sixty-eight cubic yards dredged, 15,032 in all, the dredging being at various points from Puddledock to the city; in all, over a space of 6,850 feet in length. The result was a channel 12 feet deep at high-water, with not less than 40 feet width. $2,330.89.

June, 1881.—Proposals received for widening Puddledock channel and contract made, the specifications for the work being as follows:

SPECIFICATIONS.

1. It is proposed to widen Puddledock Cut as follows, viz, to excavate the material which is 1 foot and over above mean low-tide, for a width of about 20 feet. The entire length of the cut will be about 9,600 feet, of which 6,600 feet will be on the right bank, and the remainder on the left bank, the cut at the lower end, on the left side, gradually decreasing in width to nothing; the remainder of the 20 feet in width will be excavated on the left bank immediately opposite.

The material excavated will be deposited parallel to the line of the enlarged channel on the ground, leaving a space between the new cut and the dump at least 50 feet wide; no part of the material will be dumped into the water, in Puddledock Cut. The surface, including all the ground needed for dumping purposes, must be cleared of brush and undergrowth, and the price for excavation will cover the cost of this clearing.

The rise of the tide is about 3 feet, and the cutting above mean high-tide averages about 1′ 5″ in depth, a small amount being 8½ feet above. Two feet in depth of cutting will be below high-tide and 1 foot above low-tide. The material is a tolerably stiff earth, with numerous roots embedded in it. The greater depth of cutting mentioned is in a gravelly earth, deposited on the sides from previous cuttings. No proposal will be considered unless the bidder has examined the work, and the proposal should so state.

2. The material will be measured in place before it is excavated; and no allowance will be made for excavation below the datum-line; but the excavation must be carried as low as the datum-line before the work is accepted.

3. The bids will be for two classes of excavation, viz: 1st. For all above mean high-tide, amounting to about 9,000 cubic yards. 2d. All between 1 foot above low-tide and high-tide, and additional cutting of 2 feet in depth, at the most; 13,500 cubic yards; total 22,500 cubic yards.

The contract is with Mr. Simond West, of Petersburg, the price being 20 cents per cubic yard.

The breach in the closure wall has been repaired, the old material being collected and used again as far as possible, two mats placed and loaded, and brush for third cut, $2,959.76.

The appropriation of March 3, 1881, was by its terms partly applicable to the improvement of the "harbor at Petersburg," though no estimate therefor was ever made by the Engineer Department, or, as far as known, by any one, up to that time. That harbor is but a part of the river in front of the city. The river is narrow, and the harbor is therefore contracted, but apparently large enough for the requirements of its small river commerce. It is a difficult question to decide what the United States should do in this case, as there is little else to be done than deepen the river in front of the wharves of private parties or corporations or of the city. It has generally been supposed that such things should not be done by the United States. However, as Congress has directed such work it is proposed to continue up into the city limits the channel from below, with a width of about 40 feet at bottom and a depth of 12 feet at high-water. It may be proper also to excavate a turning basin for steamers. At present no large steamers can turn round in the harbor. To do these things may require the removal of some rock, an expensive operation.

A scheme of partial diversion of the river into another channel, originated by the late Mr. Bird, has been strongly urged by some. It is worthy of careful examination, but some surveys are needed to decide as to its practicability, its cost, and its propriety. When this survey and that of the "harbor" are made, and the cost of what is necessary or desirable can be ascertained satisfactorily, a special report will be submitted, and in time for the consideration of the subject by Congress at its next session.

The small extent of work of any one class possible on the Appomattox at any one time, with the small appropriations available from time to time, make it difficult to get contractors to take hold of it for reasonable rates, especially as the work is usually of a character requiring to be done at once for the relief of commerce. This work consists generally of dredging in places where the unfinished system of improvement permits still the deposition of sediment in freshets. Sometimes it consists in the repairs required for the timber wing-dams and training walls due to injuries by ice or high-water, or both. Such repairs should be always made promptly.

There should be a dredge-boat always available in the harbor of Petersburg. The city of Petersburg owns one, and it would be to her interest to keep it in repair. The United States should possess a pile-driver and a small tow-boat.

If these three pieces of machinery could be always available the good condition of the river could be assured with a small annual appropriation from Congress to do what the United States generally does, if the city would also do its part and look after its harbor.

Money statement.

July 1, 1880, amount available	$20,194 74	
Amount appropriated by act approved March 3, 1881	20,000 00	
		$40,194 74
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		19,893 14
July 1, 1881, amount available		20,301 60

Abstract of proposals, Appomattox River, opened at 12.5 p. m., August 2, 1880.

No.	Name.	Price per cubic yard excavation, removal, and redeposit.	Price per cubic yard for placing material on scows, the United States to do balance.	Price per hour for furnishing machinery.	Remarks.
1	G. H. Ferris	$0 35	$0 28	$7 50	One dredge, capacity not less than 300 cubic yards per day, and three scows.

Contract with G. H. Ferris, at 28 cents per cubic yard.

Abstract of proposals for dredging Appomattox River, Virginia, opened at 12.5 p. m., February 7, 1881.

No.	Name.	Residence.	Time.		Price per cubic yard.	Remarks.
			Commence.	Complete.		
1	E. W. Ferris	Baltimore	April 1, 1881	June 1, 1881	$0 28 35	Bid modified to read: "Distance to dump not to exceed 1,000 yards from place of excavation.

Contract with E. W. Ferris.

Abstract of proposals for steam launch for Appomattox River, Virginia, opened at 12.5 p. m., May 10, 1881.

No.	Name.	Residence.	Price.
1	Eliza Myers	Baltimore	$1,200 00
2	Jas. Clark & Co	Baltimore	1,300 00
3	E. T. Copeland	New York	4,000 00
4	Wm. E. Brown	Norfolk, Va	3,500 00

Rejected; too high.

Abstract of proposals for excavating at Puddledock Cut, Appomattox River, Virginia, opened at noon of June 15, 1881.

No.	Name.	Residence.	Price per cubic yard.	Remarks.
1	Simond West	Petersburg, Va	$0 23	For 13,500 cubic yards the class called first by him, but improperly, as the specifications show the quantity to be the second class.
			0 20	For 22,500 cubic yards called by him second class, but improperly, as the specifications show, this being the total amount of both classes.
2	D. M. Dunlop	do	0 35	For class called first.
			0 25	For class called second.

Contract with Simond West.

COMMERCIAL STATISTICS.

TONNAGE OF VESSELS ENTERING THE PORT OF PETERSBURG FOR 1877.

		Tonnage.
Number of schooners	176	11,996.60
Number of sloops	118	1,242.20
Number of steamers	10	975.65
Number of steam tugs	288	4,053.87
Number of barges	51	2,762.71
Total number vessels	643	21,031.03

TONNAGE OF THE PORT OF PETERSBURG FOR 1878.

		Tonnage.
Number of schooners	188	13,472.60
Number of sloops	126	1,216.49
Number of steamers	14	1,648.92
Number of steam tugs	269	3,350.06
Number of barges	69	2,614.28
Total number vessels	666	22,302.35

TONNAGE OF THE PORT OF PETERSBURG FOR 1879.

		Tonnage.
Number of schooners	206	14,334.91
Number of sloops	82	777.22
Number of steamers	14	734.29
Number of steam tugs	238	3,673.64
Number of barges	44	1,815.78
Total number vessels	584	21,335.84

TONNAGE OF THE PORT OF PETERSBURG FOR 1880.

		Tonnage.
Number of schooners	208	19,085.27
Number of sloops	75	681.48
Number of steamers	40	2,165.07
Number of tug boats	348	5,690.46
Number of barges	80	3,010.24
Total number vessels	751	30,632.52

TONNAGE OF THE PORT OF PETERSBURG FROM JANUARY 1, 1881, TO MAY 24, 1881.

Tonnage to and from New York	3,750.14
Tonnage to and from Philadelphia	1,266.26
Tonnage to and from Maine	490.34
Tonnage to and from Baltimore	1,811.49
Tonnage to and from all other ports	11,562.79
Total amount tonnage, say for 4¾ months	18,881.02

All of the above was furnished by the port warden from his books.

COMMERCE OF THE PORT OF PETERSBURG FOR 1880.

Inward.

Coal	tons..	11,859
Guano	do...	5,137
Plaster	do...	500
Ice	do...	3,301
Corn	bushels..	34,500
Wheat	do...	8,700
Agricultural lime	do...	46,000
Oyster shells	do...	29,439
Builders' lime	barrels..	1,282
Hay	bales..	4,600
Salt	sacks..	2,800
Peanuts	do...	2,424
Lumber	feet..	379,615
Potatoes	bushels..	3,500

Outward.

Pine lumber	feet..	3,500,000
Oak lumber	do...	618,000
Railroad ties		10,586
Staves	number..	99,300
Wood	cords..	3,300
Barrels	number..	8,000

It is proper to state in this report, that though the commerce of the port shows a gratifying increase for the time mentioned (say 4⅔ months), our harbor was closed for nearly two months of this time by ice.

There are two large schooners chartered for the year by one party to run regularly to and from this place to the city of New York—the Francis Shubert of 217 tons, and the Lizzie D. Small of 186 tons. They calculate to make from 15 to 18 round trips each in the season. Two other large wood dealers are making arrangements to ship regularly from this place.

We have one steamer running regularly to this place, making two trips per week from the lower James river.

Very respectfully, your obedient servant,

M. RIDDLE.

Lieut. Col. WM. P. CRAIGHILL,
United States Engineer Corps.

G 20.

IMPROVEMENT OF THE SHENANDOAH RIVER, WEST VIRGINIA.

By direction of Congress a reconnaissance of this river in Virginia and West Virginia was made in 1879. The report was printed in the Annual Report of the Chief of Engineers for 1880, commencing with page 662.

The main facts developed were that a portion of the river from Harper's Ferry to Little's Falls had been already improved by locks, dams, and sluices many years ago, under authority of the State of Virginia, and sluices had also been made for some distance higher up.

The works in West Virginia had later passed under the control of a company incorporated by that State, which had spent some money on them. The severe freshets of 1870 and 1877 had practically destroyed the navigation of the river, the importance of which had become manifestly less since the actual completion of the Valley Branch of the Baltimore and Ohio Railroad, as well as that of a large part of the Shenandoah Valley Railroad.

Congress granted $15,000 June 14, 1880, for the portion of the river in West Virginia. A second appropriation of $2,500 was made March 3, 1881, but a proviso to the latter prohibited the expenditure of either until the surrender to the United States of any corporate rights or franchises over the river held under State authority.

The relinquishment not having as yet been made, no work has been done on the river.

Money statement.

July 1, 1880, amount available	$15,000 00	
Amount appropriated by act approved March 3, 1881	2,500 00	
		$17,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		187 80
July 1, 1881, amount available		17,312 20
Amount (estimated) required for completion of existing project		7,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		7,500 00

G 21.

IMPROVEMENT OF NEW RIVER FROM THE MOUTH OF WILSON, IN GRAYSON COUNTY, VIRGINIA, TO THE MOUTH OF THE GREENBRIER RIVER IN WEST VIRGINIA.

The operations of 1880 subsequent to June 30 appear in detail from the following report of Col. W. P. Smith, Assistant Engineer, dated April 8, 1881:

BALTIMORE, MARYLAND, *April* 8, 1881

COLONEL: I have the honor to submit the following report of operations on New River, Virginia and West Virginia, for the season of 1880.

A project for the expenditure of $12,000 appropriated for this work, from the mouth of the Greenbrier up, for the fiscal year ending June 30, 1881, was submitted to and approved by you early in July.

On the 26th I went to Hinton, W. Va., and commenced the work on the 2d of August, with a force of about 70 men, divided into two parties, under competent foremen. Later in the season another force was organized, composed of from 12 to 15 men, to make necessary improvements in the channel already made. The interval, from 26th July to 2d August, was used in getting ready for the work.

From August 2 to October 31 the work was carried on with good results; after that a party of 15 men was employed in trimming up the walls and getting out loose stone.

The latter part of the season being cool, the men dropped off considerably, reducing the general average for the whole time to fifty.

Out of eighty-nine working days only eight were lost; the gauge standing at or near zero, ordinary low-water never reading more than 1 foot above, nor 0.5 foot below.

The improvement of the former work consisted in building two walls in Greenbrier Shoals to check cross-currents and placing a ring-bolt at the head of the lower one; gravel taken out of the lower part of Land Craft's Shoal; stone removed from Garten's Ledges and Ellis Shoals; wall renovated at Bull's Fall; stone taken out, and channel widened at Tom's Run; width of channel increased from 30 feet to 50 feet in the upper 1,000 feet of War Ford Shoals, and on the south side a natural channel behind an island, 600 feet long, improved by blasting the rock at the upper and lower ends, and cutting off intermediate points; the steamboat now owned by an agent of the Standard Oil Company, which company is getting out a large number of staves in this section, will use this channel in high-water going up stream, the long "chute" to be used at all times for low-water.

This part of the work covers a river space of $12\frac{1}{6}$ miles with a fall over the ledges and shoals of 44.09 feet, and with a combined length of shoals and ledges equal to 25,670 feet. This work is shown on the maps prepared the previous seasons.

The new work for 1880 consisted in opening a channel through Hubbard's and Sweeny's Ripples, three in all; Crockett's and Sweeney's Ledges, six in all; removing gravel from Indian Creek Shoals, also some loose rock, but not enough to classify, and

Crump's Ledges, five in number, composed of sound rock exceedingly hard, with iron pyrites running through it, rendering the drilling very difficult and expensive, making the average price for the season 20 cents more per cubic yard than last; the gravel, however, in Indian Creek Shoals was handled at small cost, reducing the average price to one-half what it was last season. One of the walls in Crump's Ledges will have to be extended to prevent washing of the banks; the weather got too cold to attend to it last fall.

This work covers a river space of 5¼ miles, with a fall of 10.54 feet over ledges and shoals and 6,460 feet of cutting through them, the shoals varying in length from 100 feet to 1,900 feet, the heaviest grade being less than 0.4 foot per 100 feet, levels taken with gauge reading at 0.5 foot above zero. For width or length, fall, distance from Hinton, and material taken out of shoals and ledges, reference is made to the tables.

The river is now open from Hinton Landing to McDaniell's or Harvey's Falls, a distance of 17¾ miles, with a channel 50 feet wide and 2 feet deep at ordinary and 18 inches at extreme low-water.

The actual amount of cutting through these ledges and shoals, in the entire distance, amounts to 6$\frac{1}{10}$ miles, with a fall over the same of 54.81 feet, levels taken with gauge reading nearly at zero; total fall 62 feet, averaging 3½ feet per mile.

Four thousand nine hundred and ten linear feet of new wall, averaging 8 feet wide and 3 feet high, were built, and 715 cubic yards of material put in old walls. Cost of solid rock $1.92 and gravel 71 cents per cubic yard.

Two and a half miles will carry the improvement to the mouth of Lick Creek, 20 miles above Hinton, a point which it is very desirable to reach to get freight from the rich counties adjoining, as fully set forth in Mr. A. M. Scott's report, May 26, 1879, and in mine March 30, 1880, forming a part of your annual report to the Chief of Engineers, United States Army, for 1880.

In this distance about $4,000 will have to be expended to get a channel through two falls, two ledges, and one shoal.

I would respectfully suggest that a careful survey of Neilly's or Shumate's falls and rapids, about 30 miles above Hinton, be made, with reference to a lock and dam at that point; they may possibly be improved by cutting a sluice along the left bank, but the survey should be made to ascertain its feasibility. Whole fall, 11 feet; 6 feet of this nearly vertical.

Four lines of keel boats, eight in all, now run regularly on this part of the river, the improvement enabling them to carry two-thirds more freight than formerly; for instance, 1,500 feet of lumber used to be a load; now it is 4,500 feet.

The latter part of June you notified me that I was to assume control of the improvement of this river between New River Bridge, in Pulaski County, Virginia, and the lead mines in Wythe County, Virginia, for the continuation of which $7,000 had been appropriated, as well as the expenditure of $5,000 from the lead mines to the mouth of Wilson, in Grayson County, Va.

Accordingly, about the middle of August, as soon as the work from the mouth of Greenbrier up was well under way, I went to New River Bridge and examined the river to the mouth of Reed Island Creek, 26½ miles, with a view of getting data for making a project for the expenditure of the money appropriated for this section. That accomplished, I went to the lead mines and examined the river south to the foot of what is called the "Gulf," in Carroll County, Virginia, nearly 8 miles from the mines; then returned to Hinton and submitted project, as directed, for the improvements in these localities; was notified of the approval of the same September 15, and on 18th started for New River Bridge; got to work building boats and canoes 23d, and on October 4 commenced clearing out the channels made by Captain Cuyler, United States Engineers, during the seasons of 1877 and 1878, which had been injured to a considerable extent by the severe flood of September 14, 1878.

The principal part of this work, which extends from the bridge to Peake's Creek, 12 miles, was at Buck's Falls, where the supporting walls had been washed away and channel filled up; this channel is 30 feet wide and 2 feet deep for bateaux, with walls so arranged that it can be widened and deepened for steam navigation when desired.

The weather becoming cold the work was suspended on 1st November. The force having to be moved every few days, in three small boats, caused loss of time, and consequently increased the price of getting out the limestone rock to $2.10 and gravel to 95 cents per cubic yard.

Four hundred and thirty-eight linear feet of new wall was built, averaging 7 feet wide and 3 feet high, and 73 cubic yards of material put in old walls.

This work is shown on detail maps in your office, made by Captain Cuyler, United States Engineers.

The owner of Radford Iron Furnace, 18 miles above New River Bridge, as well as those of a furnace on Little Reed Island Creek, 26½ miles from the bridge, are anxious to send iron and ores down by bateaux; and, in addition, the following may be expected to ship: Forge at mouth of Little Reed Island Creek; Barren Spring Furnace; furnace near this belonging to Graham and Robinson; Bertha Zinc Works; Falling Cliff Zinc

Works, to be started soon, and yet another, by a New York company, near the Bertha mine.

As only bateaux will navigate this stream for the present, the project submitted and approved calls for a channel 2 feet deep and 20 feet wide, which will allow rafts to pass as well as boats.

For further description of this improvement, reference is made to the following reports of Capt. J. W. Cuyler, Engineer Corps, United States Army, July 1, 1878, March 15 and July 3, 1879, forming a part of your annual report, for the same years, to the Chief of Engineers, United States Army.

These reports are referred to especially, as no new work was done this season, and all of the river gone over is minutely described therein.

From the lead mines up, it is proposed to make a channel as below, 2 feet deep and 20 feet wide, a width sufficient for bringing charcoal for the furnaces down in bateaux, and for rafts of timber, of which there is an abundance in this region; there are also large deposits of copper in Carroll County, which it is thought will be eventually mined and shipped over this route.

For 5 miles above the lead mines the obstructions in the river are about the same as described elsewhere; then the fall becomes very abrupt, as the mountains are here reached; these extend for 14 miles, which will necessarily make the work heavy for that distance.

For description of this section reference is made to my report of a survey made of this part of the river, dated January 10, 1879, contained in your annual report to the Chief of Engineers, United States Army, for the same year.

Owing to the lateness of the season, no work was done on this division.

As Foster's Falls, 37 miles above New River Bridge, offers such an obstruction to navigation as to prevent the lead mines and furnaces above from shipping their products down the river, it is respectfully recommended that a careful survey be made of them with a view to their improvement by locks and dams; "the fall is about 18 feet, over slate and limestone ledges, in 2,300 feet, with a short pool and a succession of ledges."

During the winter, the country in the vicinity of New River Bridge and the lead mines was explored in search of suitable timber for crane and other boats to be used on the works the coming season.

Much of the timber has been secured and boats are now being built.

Maps on a scale of 1 inch to 100 feet, comprised in four sheets, have been made, showing the details of the work on the Greenbrier division; also one exhibiting the readings of the water-gauge at War Ford.

Two maps showing portions of the river improved on a scale of 800 feet to an inch, one from War Ford to Harvey's Falls, 5½ miles, the other from New River Bridge to Peak's Creek, 12 miles, with appropriate references to detail sheets, accompany this report.

Tables explanatory of the work in detail, as well as others giving shipments from New River at Hinton Station, on the Chesapeake and Ohio Railway, and nine stations on the Atlantic, Mississippi and Ohio Railway, are appended.

I am indebted to Charles F. Littlepage and Reuben Hurley for valuable assistance in the execution of this work, the former on the Greenbrier division, the latter at New River Bridge and the lead mines; their judgment and good management are to be commended.

SUMMARY.

From the mouth of Wilson, in Grayson County, Virginia, to steamboat landing at Hinton, Summers County, West Virginia, 1¼ miles below the mouth of Greenbrier River, 191¼ miles. The appropriations have been made in such a manner as to divide this portion of the river into three sections, as follows:

	Miles.
Upper, or Lead Mines	62
Middle, or New River Bridge	43
Lower, or Greenbrier	86¼

Throughout this distance the navigable channel originally consisted of natural chutes through the ledges and shoals, of varying widths, rarely over 1 foot in depth, in some places so tortuous as to render navigation extremely difficult and dangerous.

The original project adopted for the improvement of these natural channels was to widen them to 30 or 50 feet, as might be required, and deepen them to 2 feet, and straighten such as needed it.

This was for keel-boat navigation; the improvement, however, to be made in such a manner as to aid the work, should a greater depth and width be required in the future.

A small steamboat, when light, draught 12 inches, having been built at Hinton, in the fall of 1878, rendered it necessary to make the channel in that section 50 feet wide at all points, and in many from 75 feet to 100 feet, the depth of 2 feet being retained.

June 30, 1880, there was a channel 50 feet wide and 2 feet deep from Hinton Landing to Hubbard's Ripple, a distance by river of 12¼ miles, giving an outlet to the products of Mercer County, West Virginia.

At the close of the season's work for 1880, there was a channel of the same width and depth, from Hinton Landing to McDaniell's or Harvey's Falls, a distance of 17¾ miles, giving an outlet to the farmers and graziers of Crump's Bottom and the Indian Creek country. And in addition to the above there are 12 miles of improvement from New River Bridge to Peak's Creek, with a channel 30 feet wide and 2 feet deep, giving outlet for timber and farm products, but not available for iron or ores until Radford Furnace can be reached.

The appropriation for the fiscal year ending June 30, 1882, will carry the improvement on the Greenbrier division through Wiley's Falls, 26 miles above Hinton, passing the mouth of Lick Creek, 20 miles above Hinton, thus opening up the trade from Tazewell and other rich counties adjoining.

The project as far as Lick Creek has been approved.

The appropriation for the fiscal year ending June 30, 1882, will carry the improvement on the New River Bridge division to Carter's Ferry, 33 miles above the bridge, and give an outlet to the iron from Radford Furnace, 18 miles above the bridge, to the ores from an iron mine 8 miles beyond, to Graham's new furnace and iron works, the former 31 miles and the latter 33 miles above the bridge, as well as to two zinc mines in the same section. The project as far as Jones's Ford Shoals, 20¼ miles above New River Bridge, has been approved.

The appropriation for the fiscal year ending June 30, 1881, will carry the improvement on the Lead Mines division to the "Gulf," 8 miles above the mines, giving outlet to charcoal and timber. This project has already been approved. No appropriation for the fiscal year ending June 30, 1882.

With a channel, as now proposed, 20 feet wide and 2 feet deep, the estimate of $205,000 would be sufficient to complete it; but as that portion from Hinton to New River Bridge has to be made 50 feet wide, at a cost of about $2,000 per mile, the above amount should be increased to $275,000, and if it becomes absolutely necessary to use locks and dams for the improvement of some of the falls this estimate will have to be further increased by the amount of their cost.

The tables give a clear exhibit of the products shipped from the valley of New River at the various railroad stations in 1880, and also the tonnage received for the same section.

On the lower division there are eight keel-boats, 6 tons each, 18 inches draught, loaded. One small stern-wheel steamboat, 30 tons, 18 inches draught, loaded, and another being built.

On the middle division two keel-boats, of the same tonnage and draught as above, are in use carrying ores, and 6 more building.

On the upper division only canoes are in use. Many rafts are on each of these divisions, but their number was not ascertained.

Respectfully submitted,

WM. PROCTOR SMITH,
Assistant Engineer.

Lieut. Col. WM. P. CRAIGHILL,
United States Engineer.

Table showing the distances from steamboat landing at Hinton, W. Va., to foot of shoals or ledges, their length or width, and difference of level between the head and foot of same; also, the quantity and quality of material excavated in making and improving the channel in 1880.

Shoal or ledge.	Distance.	Length or width.	Fall.	Solid rock.	Gravel.	Total.
	Miles.	*Feet.*	*Feet.*	*Cub. yds.*	*Cub. yds.*	*Cub. yds.*
Ledges and shoals from Hinton to and including War Ford.	12⅛	25, 070	44. 09	628	296	924
Hubbard's Ripple	12⅜	100	0. 20	88	44	132
Sweeny's Ledges	12¾	1, 860	2. 47	509	....	509
Sweeny's Ripples	13½	1, 150	0. 93	70	70	140
Crockett's Ledges	14⅝	500	1. 92	373	....	373
Indian Creek Shoals	15⅜	1, 350	3. 06	....	908	908
Crump's Ledges	15⅔	1, 500	2. 14	2, 075	....	2, 075
Total	....	32, 130	54. 81	3, 743	1, 318	5, 061

Table showing the same as above for falls, shoals, and ripples, worked at during the season of 1880, on the middle division, New River Bridge being the initial point.

Falls, shoals, and ripples.	Distance.	Length or width.	Fall.	Solid rock.	Gravel.	Total.
	Miles.	*Feet.*	*Feet.*	*Cub. yds.*	*Cub. yds.*	*Cub. yds.*
Ripple No. 1	⅕	110	*0. 54	50	....	50
Ripple No. 2	⅓	20	*0. 50	2	....	2
Ingle's Falls	2¾	2, 640	7. 11	....	14	14
Moore's Gravel	6⅖	2, 200	*2. 79	....	5	5
Buck's Falls	7⅚	400	*1. 00	91	333	424
Egypt Falls	8⅙	700	*0. 98	6	....	6
Peak's Creek, shoals, and ledges	10⅝	6, 661	13. 48	10	....	10
Total		12, 731	26. 40	159	352	511

* Levels need verifying.

TABLE SHOWING THE DETAILS OF BLASTING FROM HINTON, WEST VA, UP THE RIVER, 1880.

Number of holes drilled		2, 932
Number of feet of drilling		4, 984
Number of blasts fired		3, 066
Number of blasts missed		24
Number of blasts fired under bowlders		110
Average depth of holes	feet.	1. 70
Average depth of holes drilled per day per drill	do ..	11. 50
Average charge of powder	pounds.	0. 38
Average loosening of rock per blast	cubic yards.	1. 22

TEBLE SHOWING THE DETAILS OF BLASTING FROM NEW RIVER BRIDGE, SOUTH, 1880.

Number of holes drilled		138
Number of feet of drilling		230
Number of misses		2
Average depth of holes	feet.	1. 75

Statement of tonnage sent from and received at Hinton Station, Chesapeake and Ohio Railway, for the fiscal year ending September 30, 1880.—[Furnished by R. H. Fisher, Auditor.]

Articles.	Hinton.		New River.	
	Sent.	Received.	From—	To—
Lumber	14, 194. 24	70. 52	2, 180. 00	....
Coal	99. 12	530. 52	....	....
Salt	20. 96	285. 16	....	6. 10
Bacon	27. 20	22. 52	20. 40	22. 32
Lard	2. 12	100. 40	2. 12	100. 40
Flour	3. 20	57. 60	....	....
Whisky	. 80	5. 28	....	....
Merchandise	136. 32	838. 56	55. 40	644. 20
Wheat	1, 746. 48	....	1, 251. 28	....
Hay	97. 28	30. 00	97. 28	30. 00
Butter	25. 36	....	25. 36	....
Cattle	41. 52	....	41. 52	....
Eggs	25. 28	....	25. 28	....
Horses	15. 00	....	....	....
Sheep	40. 36	....	40. 36	....
Wool	46. 56	....	46. 56	....
Corn	104. 20	....	104. 20	....
Dried fruit	27. 76	....	27. 76	....
Rye	. 28	....	28	....
Flaxseed	24. 88	....	24. 88	....
Leaf tobacco	401. 80	....	401. 80	....
Oats	2. 68	....	2. 68	....
Sundries	8, 309. 56	108. 56	6, 225. 56	55. 00
Total	25, 392. 96	2, 049. 12	10, 572. 72	858. 22

This table shows that 41½ per cent. of the products shipped from and to Hinton is from the section of New River now being improved; 409 tons from New River were shipped at Lowell, a station on Greenbrier River, and 87 tons sent thereto.

Statement of tonnage sent from and received at the following stations on the Atlantic, Mississippi and Ohio Railway for the year ending December 31, 1880.

[Furnished by E. E. Portlock, auditor.]

Name of stations.	Sent.	Received.	General classification of tonnage sent.	
			Products.	Tons.
	Tons.	*Tons.*		
Christiansburg	4,816.72	2,104.55	Of animals	8,098.57
Central	719.70	182.20	Of agriculture	4,143.79
New River	987.53	253.61	Of the forest	612.75
Dublin	3,937.31	1,326.17	Of manufactures	265.06
Martin's	5,335.00	4,508.36	Of the mines	12,704.58
Max Meadow	4,109.22	1.382.40	Of vegetables	565.11
Wytheville	2,495.31	2,415.64	Other articles	358.68
Crockett	3,822.68	604.51	Miscellaneous	1,136.89
Rural Retreat	1,661.96	552.93		
Total	27,885.43	13,330.37		27,885.43

The above is all from the two upper sections of New River now being improved, and it may be safely asserted that not less than one-third of this amount will be shipped by water as soon as the channel is made.

Of the products of the mines, which amount to 7,044 tons, exclusive of coal, seven-eighths will be carried in boats down to New River Bridge Station.

The proportion of tonnage received, that will be sent over this route, could not be ascertained.

W. P. S.

Operations were suspended at the close of October, 1880, and not resumed until May, 1881. As much of the work is done by men in the water, it can only be carried on when the water is low, is clear, and not too cold.

An appropriation of $24,000 was made March 3, 1881, for the application of which a project, given below, was submitted to the Chief of Engineers April 27, 1881, and by him soon after approved. Under this and previous projects the work has been actively continued to the end of the fiscal year, and will be as long as the state of the river allows in 1881, and will be resumed as early as possible in 1882.

Money statement.

July 1, 1880, amount available	$24,083 26	
Amount appropriated by act approved March 3, 1881	24,000 00	
		$48,083 26
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		16,179 09
July 1, 1881, amount available		31,904 17
Amount (estimated) required for compl tion of existing project		181,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		25,000 00

PROJECT OF LIEUTENANT-COLONEL WILLIAM P. CRAIGHILL, CORPS OF ENGINEERS.

BALTIMORE, MD., *April* 27, 1881.

GENERAL: In accordance with your instructions I have the honor to submit below a project for the expenditure of the appropriation of March 3, 1881, for the New River in Virginia and West Virginia.

The phraseology of the appropriation is the following:

> Improving New River from the Lead Mines in Wythe County, Virginia, to mouth of Greenbrier River, $24,000, of which sum $15,000 shall be expended in the continuation of the work from the mouth of Greenbrier up and $9,000 in the continuation of the work from the Lead Mines to Wythe County down.

The general plan of improvement adopted has had reference to a navigation by the boats now in use on the river. This has consisted of making a channel 2 feet deep at ordinary low-water and 18 inches deep at extreme low-water, and varying in width from 30 to 50 feet according to location and direction. In some extraordinary cases, where the channel is necessarily quite crooked, an additional width of from 25 to 50 feet has been given.

This plan involves blasting above and below water and the removal of ledges and bowlders, placing the *débris* in wing dams and training walls, excavating through gravel shoals and placing the material in the hearts of the dams, and thus making sluices and chutes, affording an improved water-way without too much increasing the velocity and volume of the water in them.

It is proposed to continue this method of improvement in the expenditure of the last appropriation, distributing the work as follows:

1. IN THE SECTION FROM HINTON OR THE MOUTH OF THE GREENBRIER UP.

To complete work already begun from the mouth of Greenbrier to Lick Creek, 20 miles in extent	$1,500
At mouth of Lick Creek	250
At Shanklin's Ferry Ledge, 20¼ miles from Hinton	250
At Shanklin's Ford Shoal, 20¾ miles from Hinton	2,150
Shoals, 21 miles above Hinton	450
Walker's Lower Shoals, 21¾ miles above Hinton	500
Walker's Upper Shoals, 22½ miles above Hinton	3,100
Pendleton's Ledge, 24 miles above Hinton	300
Pendleton's Shoals, 24 miles above Hinton	750
Round Bottom, 24½ miles above Hinton	700
Shoals, ripples, and ledges between Round Bottom and Wiley's Falls, 25 miles above Hinton	2,050
Wiley's Falls, 25½ miles above Hinton	2,500
Surveys (and estimates) of Neilly's Falls, to decide whether a sluice may be made or a lock necessary, 30 miles above Hinton	500
	15,000

2. IN THE SECTION FROM THE LEAD MINES IN WYTHE COUNTY DOWN.

Nunn's Ledges, 21.6 miles above New River Bridge	$500
Ledge just below Clark's Falls	125
Clark's Falls, 22.8 miles above New River Bridge	950
Clark's Ledges, 22.9 miles above New River Bridge	550
Lake Island ledge, 23 miles above New River Bridge	625
Hollingsworth Branch ledge, 23 miles above New River Bridge	100
Burden's Ledge, 24.8 miles above New River Bridge	200
Ledge, 25.6 miles above New River Bridge	100
Crumm's ledges and shoals, 26.6 miles above New River Bridge	1,300
Howard's ledges, 26.9 miles above New River Bridge	250
Pine Run Shoals and Rapids, 27.7 miles above New River Bridge	3,500
Ledge, 31.5 miles above New River Bridge	150
Sawyer's Shoals, 32 miles above New River Bridge	150
Survey of Foster's Falls, 37 miles above the bridge, to locate locks and dams, (these falls are 18 feet in height)	500
	9,000

The foregoing distribution is necessarily approximate, but is as near as can be made until the work is actually in hand, which is very irregular in character, and such that accurate estimates and specifications of the details in extent and kind cannot be given. This irregularity has led to the rejection of the contract system on this river up to this time, and to the adoption of the method of procuring materials, boats, and machinery, and labor by open purchase and hire when needed.

It is recommended that this latter method be continued as most economical and satisfactory. It is not expected to expend more than $15,000 of the appropriation in 1881, but to carry the operations over to the end of the fiscal year terminating June 30, 1882.

Very respectfully, your obedient servant,

WM. P. CRAIGHILL,
Lieutenant-Colonel of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

G 22.

IMPROVEMENT OF THE GREAT KANAWHA RIVER, WEST VIRGINIA.

At the close of the fiscal year ending June 30, 1881, lock 3 near Paint Creek is essentially completed, and dam 3 is so well advanced that we confidently expect to finish it in 1881. Locks and dams 4 and 5 have been in successful operation during the year. Lock 6 is under contract and begun. Site 7 is in the possession of the United States. Negotiations for site 2 are still in progress. The details of operations are fully set forth in the attached report of Capt. E. H. Ruffner, Corps of Engineers, who is the resident engineer supervising the work.

Money statement.

July 1, 1880, amount available	$273,319 68	
Amount appropriated by act approved March 3, 1881	200,000 00	
		$473,319 68
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		152,701 44
July 1, 1881, amount available		320,618 24
Amount (estimated) required for completion of existing project		2,250,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		350,000 00

REPORT OF CAPTAIN E. H. RUFFNER, CORPS OF ENGINEERS.

CHARLESTON, KANAWHA COUNTY, WEST VIRGINIA,
June 14, 1881.

SIR: I submit the following annual report of progress in the improvement of the Great Kanawha River, for the fiscal year 1880-'81. The object of the present improvement, and its history to that date, having been given in the last annual report, it is conceived that its repetition here is not required of me. The report referred to states the condition of the improvement at that date, July 1, 1880, and from it I quote the necessary items in their proper places.

LOCK AND DAM No. 3.

The *personnel* at that dam remains unchanged, except that United States Inspector Minnick was on duty there during a part of the year, and recently United States Inspector Kirlin was charged with the special duty of preparing the foundation for the cribs of the dam. On the date of the last report 12,839 cubic yards of masonry had been laid, leaving 5,180 yet to complete the lock.

The land wall had been built from 26 to 29 feet above the rock; the river wall was completed to about 10 feet above the lower miter sill, with a portion built 7 feet higher. Arrangements had been made for the timber for the dam, and delivery of it had begun.

During the past year work upon the lock has progressed without any extra or unexpected delay, and as rapidly as was really necessary. The completion of masonry, before the commencement of the dam, was not required; and the repeated delays in the delivery of timber for the dam caused the postponement of its construction. It is hardly necessary to enter into the details of the causes for these delays.

They have been repeatedly touched upon in the annual reports, and are the principal cause for the non-completion of the lock and dam last year.

Had half of the timber been on hand early in the season, the dam would have been begun; whereas, after waiting a full year longer, and adopting every imaginable device for securing it and hastening its delivery, there are still some 300,000 feet to be delivered to complete the various bills for the dam, cribs, and gates. The masonry upon the lock at the close of the year, shows the river wall completed, excepting a few stones at the head and a few at the foot, which can be put in whenever desired. The placing of the irons for the gates called for extra care and attention, and those points on the walls are, for the present, left unfinished. Upon the river wall masonry is not hurried, as it is desirable to complete the miter and guard walls first, as the handling of stone is less. At the end of the year the state of this wall is as follows:

Unfinished.

Courses.	Lower end.	Upper end.
Coping	76 feet	242 feet.
1	51 feet	126 feet.
2		112 feet.
3		105½ feet.
4		90 feet.
5		49 feet.
6		42 feet.

The laying of the remainder can proceed now with rapidity, as the completion of the interior walls will shortly be a fact. The guard wall at the head of the lock has been carried up to within two courses of completion, and only awaits the miter wall.

The miter wall was carried up from the rock to the bottom of the culverts, and of the different pillars the central one was completed to the capping, 1 side pillar also, and 2 of the narrow interior ones, 1 course each. Since the 1st of June, however, as particular attention is paid to this part of the work it has progressed rapidly and there is no doubt it will be completed by 1st July, as the stone is all cut and ready to lay. The paving on the land and land wall is nearly complete to the head of the land wall. Nearly 2,200 yards of paving have been laid. The cribs at the foot of the lock are done; those at the head are nearly ready to begin work on.

The procurement of stone for the filling of the dam has been in progress for the entire year, and large amounts are piled near the lock for early use, and also near the abutment. The dredge was set to work on trench for the foundation of the dam on May 2, and has been at work as continuously during the day since, as breakages would allow. About 250 feet in length has been about two-thirds opened, and the first crib for the dam was put in on the 13th June. Progress in this will be so indefinite that prediction will be useless.

As soon as a few cribs are in place, work will be much facilitated, as the filling will begin, and the quarried stone used to advantage.

Extracts from monthly reports of No. 3.

	Masonry.			Stone cut, superficial feet.				Timber, feet, B. M.		Number of men on roll.	Paving laid.
	Laid	Coping laid.	Cement used.	Fine.	Pointed.	Coping.	Rock face.	Received.	Framed.		
	C. yds.	*Sup. ft.*	*Brls.*								*C. yds.*
July	1,364	560	812							207	
August	574		430	840.5	962.45	413.66	216.83			234	
September	547	566.45	331	856.25	1,222.16	663	672.75	*135,832	47,450	267	
October	591	616.05	294½	819	1,348	1,469	1,256		19,550	270	371
November	225	626	179	319.75	769.25	412.16	429.41	66,251	8,867	248	543
December			7							94	162
January										80	202
February								5,985		85	406
March				152.25	531.25	603.09	319.33	39,874	52,344	144	500
April		438	24	272.16	194.92	243.25	70.75	7,995	186,939	153	
May	335		236½	381.5	456.58	67.25	755.33	51,849	318,189	220	

* Total timber delivered for dam, to September 1, 1880, 326,286 feet, B. M.

LOCK AND DAM NO. 4.

This work was practically completed on the 3d of July, 1880, when the first lockage was made. Since then the dam has been lowered and put up three times, and is up at this date, June 1. During this time the dam has been entirely up a total of 146½ days. The dates of the several movements, the time occupied in making them, &c., are as follows:

Finished raising.	Began to lower.	Number of days up.	Total hours labor expended in raising.	Total hours labor expended in lowering.
1880. July 3	September 8, 12 m	65	(*)	117
September 17, 9 a. m	November 1, 1 p. m	45⅙	66	30
November 10, 12 m	November 30, 8 p. m	20	125	47
1881. May 15, 7 p. m	Still up, June 1	16⅓	275	....
		146½		

*1 time, and not instructive.

The works are in good order and repair. The general remark relative to experience gained in maneuvering the dam, and on the effect of ice, &c., at both dams 4 and 5, will be given below in connection with the report for the latter work. In regard to the commerce, number of lockages, &c., there being no shipments of any amount in No. 5 pool, the business at the lower lock practically represents that of both, and will be given for No. 5 only.

LOCK AND DAM NO. 5.

This work was completed so that the first lockage was made July 16, 1880. Since that date the dam has been lowered and raised three times. It has been up a total of 122¾ days to June 1. The dates of the maneuvers, and the time taken to perform them, are as follows:

Finished raising.	Began to lower.	Number of days up.	Hours of labor expended in raising.	Hours of labor expended in lowering.
July 16, 12 m	September 9, 12 m	55	(*)	60
September 23, 3 p. m	November 1, 12 p. m	39½	159	20½
November 17, 9 a. m	November 30, 3 p. m	13¼	121	30
May 16, 7 a. m	Still up June 1	15	293	....
		122¾		

*1 time, and not instructive.

The following tables are summaries of the records kept at lock 5, from July 16, 1880, to June 1:

	Steamers up.	Steamers down.	Barges up.	Barges down.	Rafts down.
Through pass	454	462	125	150	10
Through lock	295	289	81	58	9
Total	749	751	206	208	19

Total number of lockages made, 609.

	Bushels of coal down.	Tons of miscellaneous freight both ways, approximate.	Passengers both ways, approximate.
Through pass	875, 800	700	5, 770
Through lock	228, 900	400	2, 885
Total	1, 104, 700	1, 100	8, 655

MANEUVERING THE DAMS.

Although considerable trouble has been had, nothing serious has occurred, and the working on the whole has been as satisfactory as could be expected. The difficulties decrease with experience, and the maneuvers are already made in much less time than at first. As was to be anticipated, the tripping bars have been the principal cause of trouble, and the desirability of getting rid of them if possible is clearly proved. They become foul from stone, gravel, sticks, and cinders (the last is quite troublesome), that get on and *under* them and *in* the gearing-wells. This is particularly the case when the dams are down, and a good deal of time and hard, disagreeable work are always required to get the bars in working order before the wickets can be righted. Besides this, they frequently fail to trip (the tripper passing the prop, as it will when the latter is not well down to its seat in the hurter), and the wicket is left standing to be pulled down from below, a slow and difficult operation. It is true that a careful examination of every prop by the diver in raising does away with the most of this difficulty, but not entirely, for a prop will sometimes be overlooked and cause the loss of precious time when the dam is thrown. It is believed that the adoption of the Pasquean hurters at both 4 and 5 is advisable, and it is respectfully recommended that steps be taken to give them a trial by placing them on one bar-section at one of the dams as soon as practicable. It is thought a small movable coffer could be devised that would allow of the placing of two or three hurters at once, and the change made at small expense.

It is found that a great deal of material, stone (some large ones), coarse gravel, sand, cinders, water-soaked wood, and mud are deposited on the work after every flood. It is generally found nearly or quite to the top of the sills, decreasing by a gentle slope below. That left immediately below the bridge sills causes considerable trouble by preventing the lowering of the trestles.

This is now kept clear by the diver, *but the importance, in any form of trestle dam, of placing this sill further up stream and of giving it as much slope as possible on the down-stream side has been demonstrated.*

A great deal of diving is found necessary, so much that it has been found impracticable to get along with one diving apparatus for both dams, and the second one is about, with your approval, to be purchased.

ICE.

The experience with ice last winter was quite severe. The most of the river was covered with ice from 5 to 8 inches thick. It was carried out when quite strong by a slight "head rise" that was just high enough to cause heavy gorges at both 4 and 5; at both places it gorged on the weirs and held till the water ran up from 5 to 6 feet above the normal level. When the gorge broke at dam 5 it carried away several of our boats and barges that were harbored below the lock, and caused some damage in this way, but it is gratifying to state that neither of the movable dams sustained any noticeable injury.

The charge of locks and dams Nos. 4 and 5 was placed with Lieutenant Black, Corps of Engineers, until he was relieved from this work, early in May, when Assistant Engineer A. M. Scott was placed in immediate supervision. This gentleman has prepared so much of this report as pertains to these dams, which is inserted in its entirety as representing not only the history of the first movable dams in America in operation, but the engineering suggestions first made as practicable experience brings out. The items of commerce cannot as yet be a critical test of this improvement, for we have now for the first year opened up as a navigable river what before was not considered as such. It should be noted that the dams are reported as up over half of the time since put into operation.

During the greater part of the year, that is, until Lieutenant Black was relieved, Assistant Engineer Scott was immediately in charge of the superintendence of the construction by the contractors of lock No. 6, and was assisted by Assistant Engineer C. McDermott.

The latter gentleman was actively engaged in overlooking the construction of the lock-house at No. 6 during the summer and fall.

The summary as to No. 6, following, was prepared by Mr Scott.

Proposals for building lock No. 6 were invited by advertisement of July 30, 1880, and received until September 7, 1880. The contract was awarded to Messrs. George Harris and William H. Black, by contract dated November 4.

The contractors went to work soon afterwards, but the early and severe winter prevented much work, and not much was done until the early spring.

Upon the 1st of June the contractors had their office, store, shops, and other buildings about complete.

They are now working in two quarries, "Preston's" and "Elk"; from the former will be obtained their backing, of which several hundred yards have been taken out, and other rough stone, and they are now in good shape to get out considerable more on short notice. At this place they have graded an incline from quarry to river, and built a crib pier to load from. They began at Elk quarry on the 18th of May, and will begin taking out stone for cutting in a day or two; this quarry having been designated as that from which the cut stone should be taken. They are doing considerable work at this quarry in cribbing and filling to water's edge to make yard-room. They got their dredge at work early in May at removing logs and trees from the site.

Owing to breakages, they have put in but 17 days with the dredge during the month. They are now dredging for the upper end of the coffer-dam, the first section of which will probably be sunk before long. The poles and plank for the coffer are nearly all on the ground.

The "grubbing" and "clearing" of bank is done. All considered, though the contractors have been too slow about getting started, particularly at the placing of the coffer, they are making satisfactory preparations towards carrying on the work. The lock-house at this point was built by day's labor, from drawings prepared in this office, and was finished, as far as contemplated at present, in January, and has since been occupied by the inspector.

SURVEYS, ETC.

Negotiations for the site of lock and dam No. 2 not having been brought to a successful issue, an attempt to locate elsewhere was resorted to, and special surveys for this purpose, including borings and topography, were made above and below Harvey's Shoals. A site was marked out below Harvey's Shoals, and some correspondence with the land-owners took place, but nothing definite was done. The survey of the river from Loup Creek to Lyken's Shoals was continued, and maps of these surveys have been made, or their results incorporated upon office maps. Much extra and final work of this kind has been done during the year at the site for No. 6, for exact information for use before the letting of the contract for the lock at that place, and since that time, in connection with the contract.

A telephone line has been put up from lock No. 3 to lock No. 6, a distance of about 26 miles, thus connecting all these locks with one or other and with the Charleston office, as well as the telegraph station at Charleston. It had been found necessary to the successful operation of the movable dams, their prompt raising and lowering, that they should communicate freely with one another and with the Charleston office. The great convenience experienced in the matter of correspondence was another reason for the building of the line, and now that it is put up, it hardly seems possible that we could have got along without it as well as we did. If now we could have it extended to Kanawha Falls, as it should be, so as to connect us with that gauge, we should be quite safe in the matter of sudden rises, and independent of telegraphs entirely, as the cards from Hinton, now sent by mail, would give us all the information necessary. Possibly the railroad company would let us put up a wire from the falls to Paint Creek, 15 miles, on their poles. If so, this could be done for, say, $300.

Lock-houses for locks Nos. 3, 4 and 5 seeming necessary, it was recommended that the usual form of "company officers' quarters," as adopted by the Quartermaster's Department of the Army, be selected, with a slight modification, and drawings of the same were prepared, together with specifications and estimates. Orders have recently been received looking to the early erection of houses at these points.

A steam tow-boat for the use of this improvement has long been needed, and was never more wanted than during the past year. As the result of much investigation and correspondence, it has been decided to take steps for obtaining one of suitable size for the work expected, and advertisements for the hull have been made.

Commercial statistics have hitherto been obtained from the Kanawha Board, but as recent legislation looks to its suspension, an effort must be made to obtain this information elsewhere, and a circular will be sent to all of the principal coal-men and others in the Kanawha Valley to ascertain the quantity of shipments made.

This cannot be obtained at once, but I hope to forward it by the middle of July.

Very respectfully, your obedient servant,

E. H. RUFFNER,
Captain of Engineers.

Lieut. Col. W. P. CRAIGHILL,
Corps of Engineers, U. S. A.

Abstract of proposals for building lock No. 6, Great Kanawha River, West Virginia, opened at 12.05 *o'clock p. m. September* 7, 1880.

	No. 1. A. Yacke, Wheeling, W. Va.	No. 2. Dull, Hefright & Dull, McVeytown, Pa.	No. 3. Harris & Black, Lancaster, Pa.	Approximate estimate of quantities.	No. 1. A. Yacke.	No. 2. Dull, Hefright & Dull.	No. 3. Harris & Black.
Grubbing and clearing, complete....	$215 00	$2, 000 00	$400 00	....	$215 00	$2, 000 00	$400 00
Excavation.............. per cu. yd..	1 00	1 00	50	21, 500	21, 500 00	21, 500 00	10, 750 00
Excavation (rock) ....do........	1 25	1 00	2 00	....	....	....	....
Embankment, in place ....per cu. yd	62	50	50	8, 500	5, 270 00	4, 250 00	4, 250 00
Puddling ....do....	1 25	1 25	1 00	1, 650	2, 062 50	2, 062 50	1, 650 00
"Cut-stone" masonry.........do ...	15 00	20 00	13 00	700	10, 500 00	14, 000 00	9, 100 00
"Pointed-face" masonry........do....	12 00	13 00	12 00	1, 250	15, 000 00	16, 250 00	15, 000 00
"Rock-face" masonry. ....do....	10 00	12 00	11 00	1, 000	10, 000 00	12, 000 00	11, 000 00
"Coping" ....do....	15 00	20 00	20 00	320	4, 800 00	6, 400 00	6, 400 00
"Quoins"..........................do....	16 00	25 00	20 00	100	1, 600 00	2, 500 00	2, 000 00
"Sills" ....do....	16 00	22 00	13 00	125	2, 000 00	2, 750 00	1, 625 00
"Backing" masonry...........do....	7 00	8 25	8 00	4, 300	30, 100 00	35, 475 00	34, 400 00
Concrete ....do....	7 00	8 00	6 00	400	2, 800 00	3, 200 00	2, 400 00
Paving...............................do....	4 00	5 50	2 50	1, 360	5, 440 00	7, 480 00	3, 400 00
Riprap ....do....	4 00	3 00	2 00	1, 950	7, 800 00	5, 850 00	3, 900 00
Stone filling for cribs...........do....	3 00	2 00	2 00	1, 250	3, 750 00	2, 500 00	2, 500 00
Timber and plank in the permanent construction, per M ft., B. M.	40 00	38 00	50 00	145, 000	5, 800 00	5, 510 00	7, 250 00
Drift bolts, per pound	08	08	12	5, 200	416 00	416 00	624 00
Bolt and dowel holes in masonry, per linear foot.	30	15	12	1, 500	450 00	225 00	180 00
Crib-logs for coffer-dam	36	20	12	43, 000	15, 480 00	8, 600 00	5, 160 00
Coffer-dam sheathing, per M ft., B. M.	40 00	22 00	40 00	22, 500	900 00	495 00	900 00
	....	....	....	....	145, 883 50	153, 463 50	122, 889 00

Contract awarded to Harris & Black.

Abstract of proposals for building the hull of a stern-wheel tow-boat; opened July 1, 1881.

Number.	Names of bidders.	Residence.	Amount for hull complete.	Dates of delivery.
1	Job E. Thayer.................	Charleston, Kanawha County, West Virginia.	$3, 950	75 days after awarding contract.
2	Marine Railway and Dry Dock Company, O. P. Tharp, superintendent.	Cincinnati, Ohio	5, 500	90 days after awarding contract.
3	Marine Dock Company, John L. Charles, president.	Point Pleasant, Mason County, West Virginia.	4, 500	75 days after awarding contract.

Contract with Job E. Thayer.

G 23.

IMPROVEMENT OF ELK RIVER, WEST VIRGINIA.

The season of work on this river is necessarily short, being confined to that of low-water. Operations were begun August 24, 1880, suspended November 13, 1880, and resumed May 5, 1881.

Their character was of the same kind as given in previous reports, and may be found as well as their extent and results explained in detail in the attached report of Capt. E. H. Ruffner, Corps of Engineers, the officer in immediate charge.

Money statement.

July 1, 1880, amount available	$6,297 78	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$11,297 78
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		3,190 80
July 1, 1881, amount available		8,106 98
Amount (estimated) required for completion of existing project		85,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		3,500 00

REPORT OF CAPTAIN E. H. RUFFNER, CORPS OF ENGINEERS.

CHARLESTON, KANAWHA COUNTY, WEST VIRGINIA,
June 14, 1881.

SIR: I have the honor to submit the following report on the improvement of the Elk River, for the fiscal year ending June 30, 1881.

Work begun August 24, 1880, and was suspended November 13, 1880. The portion of the Elk River passed over was from the mouth of Holly River to below the mouth of Otter Creek, a distance of 45 miles.

The work consisted in cutting, grubbing, and clearing underbrush and trees from islands and bars, and in breaking up and removing rocks and everything which interfered with the open navigation of the river.

Eighteen islands and bars were cut and grubbed, and one bar was removed; 103,914 cubic feet of rock were broken up and removed from places where it was an obstruction and placed in others where it was either not hurtful or where it was beneficial by giving better direction to the current.

State of navigation at present.—From the mouth of Duck Creek to the mouth of Elk River, a distance of 75 miles, boats and rafts can be run out on rises from 12 to 18 inches less in height than formerly.

From Duck Creek to the mouth of Holly River there are seven dams, and while these remain the boating stage of water must remain the same. The work done has simply lessened the danger and expense of running. This has been accomplished to a marked degree.

The laws of West Virginia give the citizens of the State power to remove these dams, and therefore the engineers have heretofore thought it advisable for the United States to do nothing with them.

Between the mouth of Otter Creek and the pool near the mouth of Elk the work can be continued in the same manner to great advantage.

Below the mouth of Big Sandy some channeling is needed. On May 5 work was again resumed on the river, with Mr. H. D. Ruffner in charge, at a salary of $90 per month and an assistant at $60 per month, under the following instructions:

"You will be allowed a cook at the rate of $30 per month, and laborers will be paid 10 cents per hour. You will procure provisions from time to time for the wants of your party, and you will send the bills to this office for payment. You will keep a record of the work done and the usual time-books, and send pay-rolls, duly signed, to this office, in duplicate, at the end of each month. All bills and pay-rolls sent by you here will be signed by you as correct before payment will be made."

He was directed to proceed at first to Mr. Samuel Fox's, at the mouth of Strange

Creek, and there get from him, and receipt for, the tools, &c., left there by Mr. Beall last year. He was then directed to proceed down the river to where work was suspended last fall, below Otter Creek, and continue the work on down, with a party large enough to do what was required, and, if it was necessary to do any work between Strange Creek and Otter, to do so on the way down.

Below that point he was directed to be guided in general by the plan of operations to be followed throughout the river, which is to remove such obstructions to navigation, as rock, snags, overhanging trees, and gravel shoals, and by the specific instructions as to certain points.

He then returned to Charleston, bought necessary supplies, shipped them on push-boats for the upper river, and went with them. He reached Tate's Island on the 18th, and, after organizing his party, resumed work below Strange Creek, and continued from that point on down the river, completing what was needed from the work of last year and the accumulations of the winter. Much timber was cut in the vicinity of Strange Creek, and much which had lodged on the head of Tate's Island was removed.

A portion of the island just below Duck Creek Dam was grubbed.

Turkey Run Bar, 1 mile below Duck Creek Dam, was cleared of all timber, as was also done at Frame Run, ½ mile lower down.

The channel at O'Brian Creek, ½ mile lower down, was improved by removing loose stone.

The channel at Grove Creek was improved by raising, extending, and straightening the wall.

One large stone was blasted here. Channel at Paddy's Defeat was worked on.

Stumps, sunken trees, and rocks removed from channel at End of World, and like work done at Twisting Chute, Log Shoal, and Two Sallies Riffle.

The channel at Water's Defeat required the raising, straightening, and extending the wall, and the removal of a rock containing, perhaps, 2 cubic yards.

At Big Otter, 12 miles above Clay Court-House, a large rock was blasted and removed to the amount of about 100 cubic yards.

Slight work was done at nearly all of the intermediate shoals to Red House, where a rock containing 166 cubic yards was removed, and several small ones were also removed.

Very respectfully, your obedient servant,

E. H. RUFFNER,
Captain of Engineers.

Lieut. Col. WM. P. CRAIGHILL,
Corps of Engineers, U. S. A.

G 24.

IMPROVEMENT OF CAPE FEAR RIVER, NORTH CAROLINA.

The stone dam at the New Inlet is essentially completed at the close of the fiscal year. The details are given in the annexed report of Mr. Henry Bacon. The suction dredge Woodbury has continued to work successfully on the Baldhead Bar, with a gain of 1 foot in depth during the year, there being now 14 feet at mean low-water. While this deepening at the Baldhead Bar has taken place, the inner bar of the western channel has become shoaler, and the changes in the neighborhood of what was once the New Inlet entrance are very extensive, and in the direction of a return to the condition of things before that inlet was opened.

A breach has occurred in the long narrow strip of sand called Smith's Island. No serious results are expected from this, but it is of sufficient importance to justify the effort to close it, and this has been begun.

A contract has been made for dredging the Snow's Marsh channel to a depth of 16 feet at mean low-water, which is the beginning of what is necessary of that kind of work to take 16 feet of water to the city of Wilmington.

The collector of the port states that the increase in collections over those of the previous year has been about 25 per cent. The president of the Chamber of Commerce of Wilmington gives a comparative statement of tonnage, &c., for five years, which shows a steady gain.

Money statement.

July 1, 1880, amount available	$95,109 45	
Amount appropriated by act approved March 3, 1881	140,000 00	
		$235,109 45
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		89,559 13
July 1, 1881, amount available		145,550 32
Amount (estimated) required for completion of existing project		410,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		300,000 00

ESTIMATE FOR DEEPENING CHANNEL OF CAPE FEAR RIVER, NORTH CAROLINA, AT ITS MOUTH.

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., January 19, 1881.

GENERAL: I have the honor to return herewith a letter, dated January 17, from the Hon. M. W. Ransom to the Secretary of War, in which he requests—

> That the Chief of Engineers will have prepared at the earliest moment, for the use of the Senate Committee of Commerce, an estimate of the probable cost of deepening the channel of the Cape Fear River, North Carolina, at its mouth, to 16, 18, and 20 feet, respectively, and his opinion in reference to the practicability and expediency of making such improvement.

This letter was received by me to-day.

It is supposed that the depths mentioned were intended to refer to mean low-water. What follows will be upon that supposition, and it may be well to state also that the rise of the tide in the Cape Fear averages between 4 and 5 feet.

I insert here an extract from the last annual report on the Cape Fear River up to June 30, 1880:

> The improvement in the Baldhead channel is apparent. A year ago there was a channel of but 12 feet depth and about 100 feet width. This has gradually increased in width and depth, until now there is a channel of 200 feet width and 13 feet depth at mean low-water entirely across the bar and inner shoal, and a plain channel of fully 14 feet depth across the main bar. The 12-foot channel is now fully 450 feet wide. On spring tides 18 feet can be carried over the Baldhead bar. A vessel drawing 17 feet 2 inches has been carried out recently. By taking proper advantage of the tides, 14½ feet can be carried up to Wilmington. The beneficial influence of the closure of New Inlet is visible also at other points between it and the Baldhead Bar, notably at the Horse Shoe Shoals, where there has been a gain in depth of at least 18 inches.

To show the improvement that has since taken place I insert here an extract from the last monthly report, dated December 31, 1880, six months later than the report quoted above:

> The Baldhead Bar is in good condition, and is now the regular ship-channel. It was never so used eight years ago. The least depth at mean low-water (on the inner shoal) is 13¼ feet. The outer shoal is nowhere (in the channel) less than 15 feet deep at mean low-water. Successive examinations seem to show satisfactorily that the entire channel (Baldhead) is gradually deepening and widening, the rate on the inner portion being less rapid than on the seaward portion.

The comparison of these two extracts shows a manifest improvement in the Cape Fear River "at its mouth," the phraseology of the letter of Senator Ransom.

This improvement is due mainly, I think, to the closure of New Inlet, and to the operations of the suction-dredge on the bar.

Here I beg leave to insert an extract from the statement of the Chief of Engineers in his last annual report as to the Cape Fear River:

> The object of the present project was to afford a channel of navigable width to the city of Wilmington from the ocean of a depth of about 12 feet at mean low-water. The main feature of the scheme was the closing of New Inlet, an unnatural mouth of the river, which was opened in a gale somewhat over a century ago. It was expected that the closing of this inlet would restore the Baldhead Channel to its condition as it existed when that was the only mouth of the river. Efforts looking in this direction had been made at various times previous to 1870, but had not succeeded. In 1870 the first appropriation was made for this river since the war, and another effort was begun toward the end in view. In the ten years since elapsing the closure of New Inlet has been essentially accomplished. The hoped-for improvement of the Baldhead Channel has resulted, and the condition of the navigation of the Cape Fear is better than it has been for more than a century.
>
> When it became apparent that the Baldhead Channel was improving, steps were taken to increase the depth to the city of Wilmington, to which only 9 feet (scant) at low-water could be taken. The worst places were the Horse Shoe Shoals, just below the New Inlet, and the "Logs," about 8 miles from town. The "Logs" Shoals was greatly improved by dredging and removing a large number of cypress stumps. The depth here was increased to 12 feet at low-water, but the channel in some places is still obstructed, and the navigation is rather difficult.
>
> An effort was made to avoid the Horse Shoe Shoal by opening, by the dredge, the Snow's Marsh Channel behind it to 50 feet, and shortening the channel considerably. The effect of the New Inlet currents, which were "cross" as regards the dredged channel, was to fill up its upper part. The attempt to keep it open was given up until New Inlet should be effectually closed. Meantime the Horse Shoe Channel has increased in depth about 18 inches. Should this improvement continue, and no greater depth of navigation than 12 feet at low-water be desired, it may be unnecessary to reopen the Snow's Marsh Channel.

From the statements made above, it appears that the depth of the Cape Fear River at its mouth, expected under the project of operations of the past ten years, is more than attained. It has not been my expectation to attain so great a depth as 16, 18, or 20 feet at low-water without the construction of one or more jetties at the mouth. The Chief of Engineers is well aware that results from the use of jetties at the mouths of rivers are not certainly to be depended upon. There is always more or less uncertainty about their use. It is my opinion at this time that the construction of one or more jetties at a cost of $250,000 may reasonably be expected to give, at the mouth of the river, a depth of 16 feet at mean low-water, probably a depth of 18 feet at mean low-water, possibly a depth of 20 feet or more.

Respectfully, your obedient servant,

WM. P. CRAIGHILL,
Lieutenant-Colonel of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

ESTIMATE FOR DEEPENING CHANNEL OF CAPE FEAR RIVER, NORTH CAROLINA, FROM ITS MOUTH TO WILMINGTON.

UNITED STATES ENGINEER OFFICE,
Baltimore, Md.. January 19, 1881.

GENERAL: In connection with the *improvement of the mouth of the Cape Fear*, as to which I have made a report of this date, in response to a call from the Hon. M. W. Ransom, for the information of the Senate Committee on Commerce, it may be proper to say something with reference to a closely kindred subject, viz, the further deepening of the river from its mouth to Wilmington, without which the further deepening at the mouth would be of much less importance commercially.

An extract is here inserted from the statement of the Chief of Engineers in his last annual report:

> When it became apparent that the Baldhead Channel was improving, steps were taken to increase the depth to the city of Wilmington, to which only 9 feet (scant) at low-water could be taken.
>
> The worst places were the Horse Shoe Shoals, just below the New Inlet and the "Logs," about 8 miles from town.
>
> The "Logs" Shoal was greatly improved by dredging and removing a large number of cypress stumps. The depth here was increased to 12 feet at low-water, but the channel in same places is still obstructed and the navigation is rather difficult.
>
> An effort was made to avoid the Horse Shoe Shoal by opening, by the dredge, the Snow's Marsh Channel behind it to 12 feet and shortening the channel considerably. The effect of the New Inlet currents, which were "cross" as regards the dredged channel, was to fill up its upper part. The attempt to keep it open was given up until New Inlet should be effectually closed. Meantime the Horse Shoe Channel has increased in depth about 18 inches. Should this improvement continue, and no greater depth of navigation than 12 feet at mean low-water be desired, it may be unnecessary to reopen the Snow's Marsh Channel.

An estimate has been prepared from careful surveys made in 1880 of the cost of dredging a channel from the mouth of the river to Wilmington 270 feet wide, and of the respective depth at mean low-water mentioned below.

14 feet will require	$200,000
16 feet will require	400,000
18 feet will require	700,000
20 feet will require	1,000,000

Respectfully, your obedient servant,

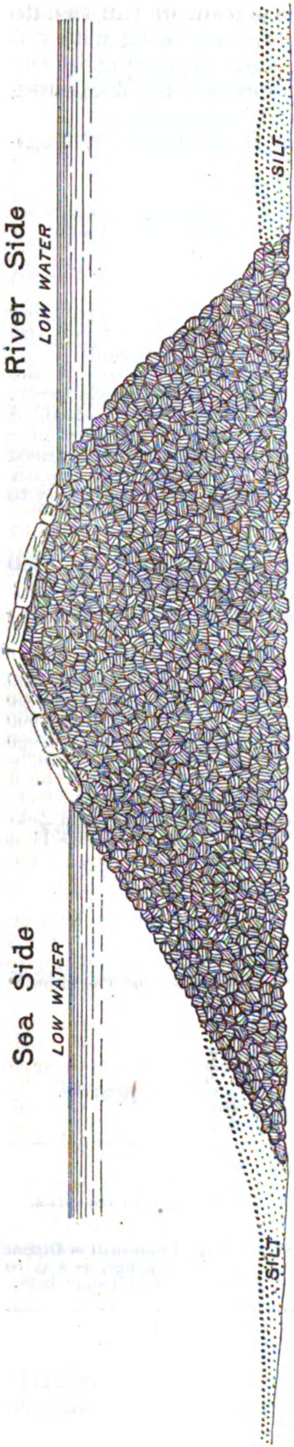
WM. P. CRAIGHILL,
Lieutenant-Colonel of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

Abstract of proposals for dredging in the Cape Fear River, North Carolina; opened at 12.05 *p. m., April* 26, 1881.

No.	Name.	Residence.	Time.		Price per cubic yard.	Remarks.
			Commence.	Complete.		
1	National Dredging Company.	Washington, D. C.	No time set.	No time set.	$0 27⅛	
2	G. C. Fobes & Co.	Baltimore	Nov. 20, 1881	Not stated	26	1 or 2 clam-shells.
3	Morris and Cumings Dredging Company	New York	No time set	No time set.	32	
4	G. H. Ferris	Baltimore	July 1, 1881.	July 1, 1882.	14⅞	Clam-shell or Dipper dredge, as may be required, or both.

Contract with G. H. Ferris



REPORT OF MR. HENRY BACON, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Smithville, N. C., June 11, 1881.

COLONEL: I have the honor to submit the following report of operations for the improvement of Cape Fear River, North Carolina, during the eleven months ending May 31, 1881.

The principal operations have been the continuation and practical completion of the stone dam across the New Inlet, and the work of the suction dredge on the Baldhead Channel at the mouth of the river.

At the beginning of the fiscal year 3,922 gross tons of heavy rock, mostly granite, from Cloumbia, S. C., had been received and laid in the sea slope of the dam extending from low-water to a foot above ordinary spring-tides. Heavy rough rock to the amount of 4,740 tons had also been delivered, to be used in the foundation of the coping and slopes.

A length of 2,022 feet of the sea slope had been finished.

The work has been steadily prosecuted till the whole dam has been thoroughly finished on both sea and river sides, excepting at the two ends, which extended into the shores, and these are now being finished with rough-faced coping.

It is expected that the whole work will be done at the end of the fiscal year.

Allowing 1,000 cubic yards of riprap, to be delivered in June, 1881, to be used at the ends and in the slopes of the dam, the whole structure will contain 170,649 cubic yards of riprap (small stone), 9,349 gross tons of heavy coping stone, and 7,107 tons of heavy rough stone.

Allowing 1¼ tons of heavy rock per cubic yard, the contents of the dam would be 181,620 cubic yards.

The whole length is 4,800 feet. The central portion of 3,600 feet length has an average height of about 37 feet and a width at the base from 75 to 120 feet.

There has been no settlement of the wide foundation during the past year or the previous two years. The small stone below half tide have become cemented together by barnacles and oysters so as to be like one solid rock. The interstices are gradually being filled, so that the amount of water passing through is constantly diminishing.

The accompanying characteristic cross-section will show the manner of finishing the dam and its general shape.

There is no certainty as to how much remains of the original mattresses of pine logs and brush on which the work was begun in 1875 and 1876.

As mentioned in former reports, the overfall of the water caused deep scouring on each side of the apron, which was finally undermined and settled, more or less, throughout most of the length.

The width of the riprap foundation is nearly double that of the apron. What the teredo worms have not destroyed is probably well covered with silt and sand; and if not, the whole cubic contents of the logs is insignificant compared with the bulk of the stone around and over them.

Stone ballast to the amount of 218 tons has been purchased and placed on the dam, equivalent to about 160 yards of riprap.

The following are the amounts of stone delivered by the contractors, Messrs. Ross and Pennypacker:

Date.	Contract stone for coping.	Rough heavy stone.	Riprap.
	Gross tons.	*Gross tons.*	*Cubic yards.*
July, 1880	872	349	499
August	1,002	497	1,605
September	535	274	1,558
October	216	480	1,652
November	343	126	830
December	524	53	1,269
January, 1881	283	12	669
February	366	121	1,118
March	342	218	1,026
April	579	145	1,583
May	365	92	1,071
Total	5,427	2,367	12,880
Previously delivered	3,922	4,740	None.
Total	9,349	7,107	12,880

All the materials were delivered on lighters at Wilmington, and towed from thence to the work by the United States steamer Jas. T. Easton.

The work of placing the heavy rock on the dam, and fitting them so as to form a faced sea slope and coping, has been done by hired labor, with the use of three floating derricks, one of which is worked by steam power. The ends of the dam extending into the shores are being finished with a covering of heavy granite, carried from the floating derricks to the shore on temporary railroad tracks.

This will prevent the possibility of the dam being flanked.

The work presents a good appearance, though only about one-tenth of the bulk of the dam is above the low-water level.

The closure of the New Inlet by the stone dam must now be considered as thoroughly successful as to stability, permanence, and results, and when the magnitude and apparent and real difficulties of the operations are considered, the cost has been small. The whole cost of the dam from Zeke's Island to Federal Point, from its inception in 1875 to its thorough completion in 1881, will not exceed $475,000.

The depth of water on each side of the dam originally caused by the scouring effect of the overfall during the process of construction is gradually decreasing by the deposits of silt and sand. In some places the bottom has filled to the extent of 8 feet.

There has been a general advance in the shore lines of Federal Point and Zeke's Island during the year, especially at the southern end of the dam at Zeke's Island and at many places on Federal Point, particularly at the junction with the Caroline Shoals, which extend from Federal Point, about 1¼ miles from the head, to the head of Smith's Island. Here the shoals have risen above high-water, extending over the site of the shoals, across the former channel for a distance of about three-fourths of a mile.

A large portion of the Caroline Shoals is now bare at low-water so that the New Inlet basin sometimes appears like a sound. It is often difficult to cross the shoals at low-water with a small boat at the most favorable places.

The long narrow beach connecting the head of Smith's Island with the main part is in the same general condition as at the beginning of the year, though a new breach has been made across it about ¼ of a mile north of the main swash. The main swash, which has been open ever since the great storm of April 13, 1877, continues to show indications of natural closure far back in the rear of the main line of the beach. It has formed a large area of shoals, bare at half tide, in the bay (Buzzard's Bay), and there can be but little doubt of its natural closure, making the beach stronger and better than before.

The new northerly swash being nearer the main body of the river and the New Inlet (though 2 miles over shoal water from the deep water and channel of the river), is considered more dangerous on account of the greater tidal currents through it.

Measures are being taken to close it by artificial means. The first attempt was made in February, 1881, by the use of scantling and sheet-piling, all driven by hand, which proved inadequate on account of the great difference in the tides of the bay and sea sides. Preparations have since been made for thorough work by heavy piles driven by a machine, with a hammer of 2,000 pounds weight, and sheet-piling to be driven by hand and protected by sand-bags. The piles, to the number of more than 400, are already driven 8 feet apart in two lines 9 feet apart. They are thoroughly cross-braced and girdered on the sea-face to receive the sheet-piling. The girders placed at high and low water are 4 by 8 inches and 4 by 6 inches, and the braces and ties 3 by 6 inches and 3 by 7 inches. The fastenings are all of wrought-iron screw and drift bolts and spikes.

The distance directly across the swash is about 700 feet. On account of the depth of the water (12 feet at low-tide) and the greater exposure to the sea, it was decided to build the closing work around the rear of the swash in shoal water, to the marsh on the southerly side, making its length about 1,500 feet, thus leaving an area which soon after the closure will be formed into a solid sand beach, which will be the future defense, though the wood-work of the dam be destroyed by the teredo worms.

There has been a gradual abrasure on the sea side of Baldhead Point and an accretion on the inner side. This has been going on continually since the stone jetties were built on the point in 1855, and probably for many years before.

The jetty of 1855 is now about ¼ of a mile from the land. The site of the land worn away is shoal, some portions of it being above low-water at times. No damage seems to be done to the main channel in consequence of this abrasion.

No great changes have occurred in the shore lines of Oak Island. There has been some accretion at the point opposite Baldhead Point, so that the distance across the entrance remains about the same.

The work of the suction dredge Woodbury on the Baldhead Channel has been satisfactory. It has been considerably hindered by the time taken for necessary repairs, and by being detached for service-towing in place of the tug Easton, while the latter was laid up for repairs. It has also been occasionally used as a dispatch boat, while the *Easton* was at her regular service. The following is the monthly record of the work done at dredging.

The materials dredged and dumped in deep water consisted mostly of sand and shells.

	Cubic yards.
July, 1880	9,102
August, 1880	5,217
September, 1880	8,105
October, 1880	8,040
November, 1880	4,736
December, 1880	3,925
January, 1881	6,233
February, 1881	3,945
March, 1881	4,628
April, 1881	5,247
May, 1881	2,866
Total	62,044

The whole cost of operation, including service, fuel, oil, waste, repairs, and deterioration, does not exceed $1,000 per month, or $11,000.

The proportion for detached service is not less than $1,693.40, leaving the cost of dredging 15 cents per cubic yard.

The large quantities of sand and shells passing rapidly through the pump, pipes, and valves, causes a heavy wear.

It has been necessary to purchase a new pump of the same capacity as the one used, but with increased thickness of metal in the parts most exposed to wear. This is now being placed in position, and at the same time extensive repairs in the boiler are being made.

The largest amount dredged in any one day was 656 cubic yards, and during this and the four succeeding days 3,108 cubic yards were dredged and dumped, being an average of 621 yards per day. The sand-bins, containing the usual load of 45 cubic yards, are often filled in 25 minutes and sometimes in less than 20 minutes.

It requires from 20 to 30 minutes to take the loads to deep-water, dump and return.

It is apparent that a boat of larger capacity would do the work more economically. A load three times as large could be dumped in about the same time.

The good effect of the dredging is apparent. The depth on the areas dredged has continued to increase, until now there is a good channel of nearly 200 feet width across the main bar, of 16 feet depth at mean low-water, and a practicable channel across the inner soft shoal of 14 feet depth, thus giving a ship channel across the bar and shoals to the deep water of the harbor of 14 feet depth at mean low-water.

The greatest depth of water is on the dredged areas, but the increase is by no means confined to them, but is general over wide areas adjacent.

This gratifying result is beyond our predictions or expectations, and brings the channel into as good a condition as before the breach of the New Inlet in 1761. It is a practical demonstration of the advantage of the closure of the New Inlet by the dam just completed.

By a proper jetty system at the mouth of the river, there is good reason to believe that 20 feet depth at low-water might be permanently attained.

The western entrance, by the "Rip" and Oak Island Channel, is seldom used, and only by vessels of very light draught. There is about 12 feet on the bar, and barely 6½ feet depth at mean low-water on the "Rip."

No marked changes have occurred in other portions of the river and harbor.

On account of the less range of the tides in the upper river towards Wilmington, and the fact that the deepest loads are outward and cannot take the full advantage of the rise of the tides without great delay, the present depth on the bar is equivalent to 16 feet depth at low-water in the river from Smithville to Wilmington. It is practicable to bring down but 14½ feet draught to Smithville, while 18 feet can be carried out over the bar at ordinary spring tides; hence the propriety of dredging a channel to 16 feet depth, where it does not already exist, from Smithville to Wilmington.

An estimate of its cost has been made at the call of Congress, and an appropriation granted for beginning the work. Proposals were advertised for, to be opened April 26, 1881.

The work was awarded to Mr. G. H. Ferris, of Baltimore, at 14¼ cents per cubic yard.

It is proposed to use the present appropriation in dredging the Snow's Marsh Channel through from deep-water above Price's Creek to 16 feet in depth above Reave's Point.

Tables are annexed showing observations of high and low water at Smithville and Federal Point for most of the working days in the year ending May 31, 1881. The gauges are at the same level as at the last report. Thirty hundredths of a foot must be subtracted from the readings at Federal Point in comparing with the reports previous to 1880.

These observations exhibit the following results, compared with those of former years:

	At Smithville.		At Federal Point.	
	1880-'81.	1879-'80.	1880-'81.	1879-'80.
Average high-water	5.10′	5.01′	4.77′	4.71′
Average low-water	0.99′	0.90′	1.49′	1.42′
Average range	4.11′	4.11′	3.28′	3.29′

From 184 similar observations in 1876 and 1877 it appears that—

Average high-water was at Smithville...........4.88; at Federal Point 4.80
Average low-water was at Smithville............0.39; at Federal Point 0.92

Average range...................................4.49 3.88

These observations and results are more for comparison as showing the effect of the closure of the New Inlet than to show the absolute average range of the tide at either place. The night tides, the range of which averages greater, are all omitted, so that the ranges shown above are less than the average.

It is still manifest that the closure of the New Inlet has resulted in raising the level of mean low-water more than 6 inches both at Federal Point and Smithville. The level of mean high-water has also been slightly raised at Smithville and remains nearly the same at Federal Point.

A few thousand small trees of various kinds were transplanted, at a small cost, to Federal Point, Zeke's and Smith's Islands from December, 1880, to April 1, 1881. Comparatively few of these will survive, the silver-leaf poplar proving the most hardy. The results do not encourage the continuance of the operation.

The original condition of the entrance to Cape Fear River before the opening of the New Inlet in 1761, according to the rather uncertain information obtained from old maps, was that of a good channel over the bar and shoals of 14 feet depth at low-water on the Baldhead Channel, in about the same position as that of the present channel.

The position and depths of the Smithville Harbor were about as they have ever since remained. The depth at the Horseshoe Shoals appears to have been about 12 feet. The earliest information as to the upper river from Campbell's Island to Wilmington is that there were shoals in several places, where there was not more than 7½ feet depth at low-water.

After the opening of the New Inlet there was a gradual deterioration at the Baldhead Channel, and variable conditions in the "Rip" Channel or Bar and in the New Inlet Bar.

There are no certain records before 1839, when the survey of Lieutenant Glynn shows 9 feet at the Baldhead Channel, 9 feet at the Western or Rip Channel, and 10 feet at the New Inlet.

The Coast Survey chart of 1851 shows the low-water depths at Baldhead Channel 8 feet, the Western Channel 7 feet, and New Inlet Bar 8 feet. The Coast Survey chart of 1866 does not show much change, the available depths appearing to be about the same.

A careful survey, made by Mr. Vinal, of the Coast Survey, in 1872, shows 9 feet at low-water at the Baldhead Channel, and the same depth at the Rip, and 10 feet at the New Inlet Bar.

No changes appear to have occurred in the upper river until improvements were made.

The improvement of the river below Wilmington was begun by the State of North Carolina, and continued from 1823 to 1828. In 1829 it was taken in hand by the United States, and from 1829 to 1838 inclusive, Congress made annual appropriations amounting to $202,539, which were expended in improving the river from Wilmington to Campbell's Island about 9 miles below.

The operations consisted mostly of pile and plank jetties, made to concentrate the currents; some dredging was also done. The plans initiated by the State were continued by the United States.

An available increase of about 2 feet in depth was obtained, so that 9 to 9¼ feet could be carried at low-water.

Projects for improvement were revived in 1852, when Congress appropriated $20,000, and $140,000 was appropriated in 1854. These appropriations were expended for the improvement at the entrance by jetties at Baldhead Point, and by closing the breaches between Smith's and Zeke's Islands. When the latter works were nearly completed and the appropriation exhausted, a great storm in September, 1857, destroyed to a considerable extent the works at Zeke's Island, leaving the stone foundations.

Nothing further was done towards improvement until 1870, when the work was begun again. The following appropriations have been made by Congress:

By act approved July 11, 1870	$100,000
By act approved March 3, 1871	75,000
By act approved June 10, 1872	100,000
By act approved March 3, 1873	100,000
By act approved June 23, 1874	150,000
By act approved March 3, 1875	150,000
By act approved August 14, 1876	132,500
By act approved June 18, 1878	160,000
By act approved March 3, 1879	100,000
By act approved June 14, 1880	70,000
By act approved March 3, 1881	140,000
Total	1,277,500

Thirty thousand dollars was appropriated March 3, 1881, for the Cape Fear River from Wilmington to Fayetteville, which is not in our jurisdiction.

The project adopted in 1870 was the closure of the breaches between Smith's and Zeke's Islands, with the ultimate closure of the New Inlet in view.

In 1873 and 1874, the additional work projected was the dredging of the new channel behind the Horse Shoe Shoals near Snow's Marsh and dredging the Baldhead Channel, (which had already begun to improve), and also dredging and removing obstacles from the river between Campbell's Island and Wilmington, so as to obtain 12 feet depth at mean low-water.

In 1875 the work of closing the New Inlet was begun in earnest.

The amount expended on these projects from 1870 to the close of the fiscal year ending June 30, 1880, was $1,042,390.55.

At the beginning of the present fiscal year there was a channel of 13 feet depth at mean low-water across the bar and shoals of the Baldhead Channel. The least depth on the Horse Shoe Shoals was 11 feet, and thence to Wilmington, the least depth was 12 feet.

At present the depth has been increased to 14 feet on the Baldhead Channel, and no diminution has occurred elsewhere. Vessels drawing 14¼ feet of water can, at ordinary spring tides, be carried from Wilmington to Smithville, and 18 feet draught from thence to the sea.

The early completion of the channel of 16 feet depth at low-water is highly necessary for the interests of commerce and navigation.

It can be more economically done, if done quickly. It can be fully completed by the close of the fiscal year ending June 30, 1883, if the funds are available.

The following is the estimate of the amount required for the completion of the present projects, embracing a channel of 270 feet width and 16 feet depth at mean low-water, from Smithville to Wilmington:

773,109¼ cubic yards dredging, under the contract of G. H. Ferris, at 14⅞, cents	$115,000	00
1,657,575 cubic yards dredging at 20 cents	331,515	00
Work for protection of Smith's Island, &c	20,000	00
Operation of suction dredge, one year	12,000	00
Add 10 per cent. for superintendence and contingencies	47,851	50
Total	526,366	50
Amount available June 30, 1881		
Amount required for year ending June 30, 1883		

On account of the large amount of dredging to be done in the country, and the increased price demanded and obtained for the same since the preliminary report on this work was made, the estimated price has been increased to 20 cents per cubic yard.

A statement of the commercial statistics of Wilmington will be prepared and forwarded herewith, or directly by Mr. A. H. Van Bokelen, the president of the Chamber of Commerce at Wilmington.

The work is in the collection district of Wilmington, N. C. The nearest port of entry is Wilmington. It is near Oak Island and Baldhead light-houses, at the mouth of the river.

Before closing this report great credit must be awarded to my assistant, Mr. B. F. Mackall, who has ably seconded me. He has had special care of the work at the New Inlet dam, and the care of the whole work during my temporary absence on other government duty.

Respectfully submitted,

HENRY BACON,
Assistant Engineer.

Lieut. Col. WM. P. CRAIGHILL,
Corps of Engineers.

Record of observations of high and low water.

JUNE, 1880.

Day of month.	High-water.						Low-water.					
	Smithville.		Federal Point.				Smithville.		Federal Point.			
	Time.		Time.	River side.	Time.	Sea side.	Time.		Time.	River side.	Time.	Sea side.
1	3.00 p. m.	4.65	3.45 p. m.	4.30	2.15 p. m.	4.50	8.30 a. m.	0.50	9.45 a. m.	1.10	7.45 a. m.	0.20
2	3.45 p. m.	4.70	5.00 p. m.	4.50	3.00 p. m.	4.30	9.30 a. m.	0.70	10.45 a. m.	1.20	9.00 a. m.	0.30
3	4.45 p. m.	5.45	5.45 p. m.	5.10	4.00 p. m.	5.60	10.30 a. m.	1.00	11.15 a. m.	1.30	9.40 a. m.	1.30
4	5.15 a. m.	4.70	6.00 a. m.	4.40	....	..	11.00 a. m.	1.20	12.00 m.	1.50	10.15 a. m.	1.30
4	5.30 p. m.	5.35	6.30 p. m.	5.00	4.45 p. m.	5.30	....	.....	....	....	....	......
5	5.45 a. m.	4.35	6.30 a. m.	4.10	....		11.45 a. m.	0.90	1.00 p. m.	1.30	10.45 a. m.	0.70
5	6.15 p. m.	5.15	....	..	5.00 p. m.	5.00	....	......	....	....	....	......
7	7.00 a. m.	4.20	8.00 a. m.	4.00	7.00 p. m.	5.10	1.15 p. m.	0.95	2.00 p. m.	1.50	12.30 p. m.	0.30
8	8.00 a. m.	4.25	8.45 a. m.	4.10	7.45 a. m.	4.00	1.45 p. m.	1.00	2.45 p. m.	1.40	1.30 p. m.	0.40
9	8.30 a. m.	4.35	9.15 a. m.	4.00	8.00 a. m.	4.30	2.15 p. m.	1.05	3.15 p. m.	1.40	1.45 p. m.	0.80
10	9.00 a. m.	4.50	9.45 a. m.	4.40	9.00 a. m.	4.30	3.15 p. m.	1.20	4.00 p. m.	1.60	2.15 p. m.	1.10
11	9.30 a. m.	4.30	10.15 a. m.	4.10	9.15 a. m.	4.10	3.45 p. m.	1.10	4.30 p. m.	1.60	3.00 p. m.	0.90
12	10.30 a. m.	4.05	11.30 a. m.	3.90	10.00 a. m.	3.80	4.30 a. m.	1.05	5.45 a. m.	1.50	....	......
12	....	....	....		....	..	4.15 p. m.	1.05	....	....	3.45 p. m.	0.80
14	12.00 m.	4.75	1.15 p. m.	4.60	11.30 a. m.	4.70	6.00 p. m.	1.70	7.00 a. m.	1.60	5.15 p. m.	1.30
15	1.15 p. m.	5.05	1.45 p. m.	4.90	12.15 p. m.	4.90	6.45 a. m.	1.40	7.45 a. m.	1.60	6.15 a. m.	1.30
16	2.00 p. m.	5.35	2.45 p. m.	5.10	1.30 p. m.	5.50	7.15 a. m.	1.30	8.30 a. m.	1.60	6.35 a. m.	1.10
17	2.45 p. m.	6.15	3.45 p. m.	5.80	2.15 p. m.	6.70	8.30 a. m.	1.65	9.15 a. m.	1.80	7.45 a. m.	2.10
18	4.00 p. m.	6.05	4.30 p. m.	5.60	3.30 p. m.	6.30	9.30 a. m.	1.50	10.15 a. m.	1.80	8.30 a. m.	1.80
19	4.45 p. m.	6.30	5.00 p. m.	5.60	4.30 p. m.	6.30	10.45 a. m.	0.95	11.45 a. m.	1.50	9.45 a. m.	1.00
21	6.00 a. m.	4.90	....	....	....	....	12.15 p. m.	0.35	....	....	....	......
21	6.30 p. m.	6.30	....	..	....	....	....	......	....	....	....	......
22	6.45 a. m.	4.80	7.30 a. m.	4.40	....	....	1.30 p. m.	0.00	....	.	12.30 p. m.	—0.50
22	7.30 p. m.	6.15	....	....	....	....	....	......	2.30 p. m.	0.90	....	......
23	8.00 a. m.	4.65	8.45 a. m.	4.30	6.45 p. m.	4.30	2.15 p. m.	0.00	3.30 p. m.	0.90	1.30 p. m.	—0.40
24	8.45 a. m.	5.00	9.30 a. m.	4.60	8.15 a. m.	4.80	2.45 p. m.	0.40	4.15 p. m.	1.20	2.30 p. m.	—0.10
25	9.45 a. m.	5.00	10.30 a. m.	4.70	9.30 a. m.	4.70	3.45 p. m.	0.65	5.00 p. m.	1.50	3.30 p. m.	0.10
26	10.30 a. m.	4.90	11.45 a. m.	4.70	10.15 a. m.	4.80	5.00 p. m.	0.75	6.00 p. m.	1.40	4.45 p. m.	0.20
28	12.30 p. m.	4.70	....	....	....	....	6.30 a. m.	0.50	7.30 a. m.	1.20	....	......
28	....	....	....	....	....	....	6.45 p. m.	1.10	....	..	....	......
29	1.45 p. m.	4.60	2.30 p. m.	4.30	12.15 p. m.	4.50	7.45 a. m.	0.55	8.30 a. m.	1.10	7.15 a. m.	0.00
30	2.15 p. m.	4.55	3.30 p. m.	4.20	1.15 p. m.	4.30	8.00 a. m.	0.75	9.15 a. m.	1.10	7.45 a. m.	0.30

Record of observations of high and low water—Continued.

JULY, 1880.

Day of month.	High-water.						Low-water.					
	Smithville.		Federal Point.				Smithville.		Federal Point.			
	Time.		Time.	River side.	Time.	Sea side.	Time.		Time.	River side.	Time.	Sea side.
1	3.15 p. m.	4.30	...	...	2.30 p. m.	3.60	9.00 a. m.	0.70	10.15 a. m.	1.00	8.30 a. m	0.00
2	4.15 p. m.	4.40	...	...	...	...	10.15 a. m.	0.60	...	...	...	...
3	4.45 p. m.	4.50	5.45 a. m.	4.20	4.00 p. m.	3.80	10.30 a. m.	0.40	11.15 a. m.	1.10	9.15 a. m.	—0.10
6	6.30 a. m.	4.10	7.15 a. m.	4.00	6.45 p. m.	4.80	12.30 p. m.	1.00	1.30 p. m.	1.30	12.00 m.	0.30
6	6.45 p. m.	5.25	...	...	...	...	...	...	...	...	...	...
7	7.30 a. m.	4.30	8.15 a. m.	4.10	7.30 a. m.	3.90	1.15 p. m.	1.05	2.15 p. m.	1.40	12.45 p. m.	0.50
8	8.00 a. m.	4.50	8.45 a. m.	4.20	8.00 a. m.	4.20	2.00 p. m.	1.05	2.45 p. m.	1.50	1.30 p. m.	0.60
9	8.45 a. m.	4.60	9.45 a. m.	4.40	8.30 a. m.	4.30	2.30 p. m.	1.05	3.30 p. m.	1.60	1.45 p. m.	0.60
10	9.15 a. m.	4.60	10.15 a. m.	4.40	9.15 a. m.	4.20	3.30 p. m.	1.20	4.45 p. m.	1.70	3.30 p. m.	0.70
12	10.45 a. m.	4.85	11.15 a. m.	4.50	10.15 a. m.	4.70	4.45 p. m.	1.30	5.45 p. m.	1.80	4.00 p. m.	1.00
13	11.45 a. m.	4.95	12.00 m.	4.70	11.15 a. m.	4.80	5.15 a. m.	1.15	6.45 a. m.	1.60	5.00 p. m.	0.80
13	...	...	...	...	...	...	5.45 p. m.	1.50	...	...	...	...
14	12.30 p. m.	5.10	1.30 p. m.	4.80	12.15 p. m.	4.80	6.15 a. m.	1.10	7.30 a. m.	1.60	5.45 p. m.	1.10
14	...	...	...	...	...	...	6.30 p. m.	1.60	...	...	...	...
15	1.30 p. m.	5.50	2.15 p. m.	5.20	12.45 p. m.	5.30	6.45 a. m.	1.40	8.00 a. m.	1.60	7.15 a. m.	1.20
16	2.15 p. m.	5.55	3.15 p. m.	5.30	1.45 p. m.	5.30	7.00 a. m.	1.45	8.45 a. m.	1.70	7.45 a. m.	1.00
17	3.15 p. m.	5.90	4.15 p. m.	5.80	2.45 p. m.	5.80	9.15 a. m.	1.10	10.15 a. m.	1.60	8.15 a. m.	0.80
19	5.15 p. m.	6.50	6.15 p. m.	5.90	5.00 p. m.	6.50	11.15 a. m.	0.90	12.00 m.	1.40	10.30 a. m.	0.80
20	6.00 a. m.	5.20	6.15 a. m.	5.10	6.00 p. m.	6.50	12.00 m.	0.85	12.45 p. m.	1.40	11.30 a. m.	0.30
20	6.15 p. m.	6.50	7.15 p. m.	6.00	...	...	...	...	...	...	...	...
21	6.30 a. m.	5.20	7.15 a. m.	4.90	6.15 a. m.	4.80	1.00 p. m.	0.45	2.15 p. m.	1.20	12.45 p. m.	0.00
21	7.15 p. m.	6.40	...	...	6.30 p. m.	6.50	...	...	...	...	...	...
22	7.45 a. m.	5.40	8.45 a. m.	5.10	7.15 a. m.	5.30	2.15 p. m.	0.60	3.15 p. m.	1.50	1.30 p. m.	0.00
23	8.45 a. m.	5.60	9.30 a. m.	5.20	8.00 a. m.	5.30	2.45 p. m.	0.45	4.15 p. m.	1.40	1.45 p. m.	—0.30
24	8.45 a. m.	5.45	10.00 a. m.	4.90	8.30 a. m.	5.20	3.15 p. m.	0.50	4.45 p. m.	1.40	...	...
26	11.15 a. m.	4.95	12 00 m.	4.70	...	...	5.00 a. m.	0.55	6.15 a. m.	1.30	...	...
26	...	...	...	...	...	...	5.30 p. m.	0.90	6.30 p. m.	1.40	...	...
27	12.00 m.	4.90	1.00 p. m.	4.70	...	...	6.15 p. m.	1.20	7.00 a. m.	1.30	...	...
27	...	...	...	...	...	...	5.45 a. m.	0.60	...	...	...	...
28	12.45 p. m.	4.75	2.00 p. m.	4.60	...	...	6.15 a. m.	0.75	7.45 a. m.	1.30	...	...
28	...	...	...	...	...	...	6.45 p. m.	1.40	...	...	...	...
29	1.45 p. m.	5.25	2.45 p. m.	5.00	...	...	7.00 a. m.	1.10	8.15 a. m.	1.40	...	...
30	2.30 p. m.	5.15	3.15 p. m.	4.90	...	...	7.45 a. m.	1.65	9.15 a. m.	1.80	...	...
31	3.15 p. m.	4.90	4.00 p. m.	4.80	...	...	8.45 a. m.	1.45	10.15 a. m.	1.60	...	...

AUGUST, 1880.

2	4.45 a. m.	4.85	6.00 p. m.	4.60	...	...	10.15 a. m.	1.10	11.15 a. m.	1.30	...	...
3	5.45 a. m.	5.05	7.00 p. m.	4.80	...	...	11.15 a. m.	0.95	12.30 p. m.	1.30	...	...
4	6.15 p. m.	5.05	7.00 p. m.	4.00	...	...	12.15 p. m.	0.85	1.15 p. m.	1.30	...	...
4	6.15 a. m.	4.20	...	...	...	...	...	...	...	...	...	...
5	7.00 a. m.	4.85	8.00 a. m.	4.20	...	...	1.15 p. m.	0.75	2.15 p. m.	1.40	...	...
6	7.15 a. m.	4.45	8.30 a. m.	4.30	...	...	1.30 p. m.	0.65	2.45 p. m.	1.30	...	...
7	8.00 a. m.	5.05	9.00 a. m.	4.80	...	...	2.30 p. m.	1.10	3.30 p. m.	1.70	...	...
9	9.30 a. m.	5.15	10.30 a. m.	5.10	...	...	3.45 p. m.	1.10	4.45 p. m.	1.80	...	...
10	10.15 a. m.	5.35	11.30 a. m.	5.40	...	...	4.30 p. m.	1.45	5.15 p. m.	2.00	...	...
11	11.15 a. m.	5.30	12.00 m.	5.50	...	...	5.15 a. m.	1.20	6.15 p. m.	1.90	...	...
11	...	...	...	...	...	...	5.15 p. m.	1.45	...	...	...	...
12	12.00 m.	5.55	1.00 p. m.	5.60	...	...	5.30 a. m.	1.30	6.45 a. m.	2.00	...	...
12	...	...	...	...	...	...	6.00 p. m.	1.55	...	...	...	...
13	1.00 p. m.	5.80	1.45 p. m.	5.70	...	...	6.15 a. m.	1.05	7.15 a. m.	1.80	...	...
13	...	...	...	...	...	...	7.15 p. m.	1.80	...	...	...	...
14	2.00 p. m.	5.85	2.45 p. m.	6.00	1.30 p. m.	5.50	7.30 a. m.	1.35	8.45 a. m.	2.00	...	...
16	4.15 p. m.	5.70	4.45 p. m.	5.50	...	...	9.45 a. m.	0.60	10.45 a. m.	1.40	...	...
17	5.15 p. m.	6.10	5.45 p. m.	5.90	...	...	10.45 a. m.	0.65	11.30 a. m.	1.40	...	...
18	5.15 a. m.	5.35	6.00 a. m	5.30	5.15 a. m.	6.30	12.00 m.	0.70	1.00 p. m.	1.40	...	...
18	5.45 p. m.	6 30	6.30 p. m.	6.10	...	...	...	...	...	...	...	...
19	6.15 a. m.	5.30	6.45 a m.	5.20	...	...	1.00 p. m.	0.40	2.00 p. m.	1.30	...	...
19	7.00 p. m.	6.25	...	...	...	...	...	...	...	...	...	...
20	7.15 a. m.	5.50	7.45 a. m.	5.30	...	...	1.45 p. m.	0.50	2.30 p. m.	1.30	...	...
21	8.15 a. m.	5 50	8.45 a. m.	5.20	7.15 a. m.	5.10	2.30 p. m.	0,50	3.45 p. m.	1.30	...	...
23	9.45 a. m.	5.45	10.15 a. m.	5.10	9.00 a. m.	5.30	4.00 p. m.	0.90	5.15 p. m.	1.30	...	...
24	10.30 a. m.	5.15	11.00 a. m.	4.90	9.45 a. m.	5.30	4.45 p. m.	1.05	5.45 p. m.	1.50	...	...
25	11.15 a. m.	5.25	11.45 a. m.	5.10	...	...	5.00 a. m.	1.10	6.15 a. m.	1.40	...	...
25	...	...	...	...	...	...	5.45 p. m.	1.75	6.30 p. m.	2.00	...	...
26	11.45 a. m.	5.15	12.30 a. m.	4.90	...	...	5.30 a. m.	1.85	6.45 a. m.	1.60	...	...
26	...	...	...	...	...	...	6.15 p. m.	1.80	...	...	...	...
27	1.00 p. m.	5.30	1.45 p. m.	5.00	...	...	6.15 a. m.	1.65	7.15 a. m.	1.70	...	...
28	1.45 p. m.	5.15	2.15 p. m.	5.00	...	...	7.15 a. m.	1.95	8.30 a. m.	2.00	...	...
30	3.45 p. m.	4.55	4.15 p. m.	4.40	...	...	9.00 a. m.	1.30	10.00 a. m.	1.40	...	...
31	4.30 p. m.	4.80	5.00 p. m.	4.60	...	...	10.15 a. m.	1.20	11.00 a. m.	1.30	...	...

Record of observations of high and low water—Continued.

SEPTEMBER, 1880.

Day of month.	High-water.						Low-water.					
	Smithville.		Federal Point.				Smithville.		Federal Point.			
	Time.		Time.	River side.	Time.	Sea side.	Time.		Time.	River side.	Time.	Sea side.
1	5. 30 p. m.	5. 40	6. 00 p. m.	5. 10	....	....	11. 00 a. m.	1. 50	12. 00 m.	1. 50	....	......
2	5. 45 a. m.	4. 95	6. 15 a. m.	4. 70	....	....	12. 00 m.	1. 40	12. 45 p. m.	1. 70	....	......
2	5. 45 p. m.	5. 55	....	....	....	....	1. 00 p. m.	......	....	....	....	......
3	6. 30 a. m.	5. 10	7. 00 a. m.	4. 90	....	....	12. 45 p. m.	1. 20	1. 30 p. m.	1. 50	....	......
4	7. 00 a. m.	5. 25	7. 45 a. m.	5. 00	....	....	1. 15 p. m.	1. 05	2. 15 p. m.	1. 60	....	......
6	8. 30 a. m.	5. 35	9. 30 a. m.	5. 00	....	....	2. 45 p. m.	0. 85	2. 45 p. m.	1. 50	....	......
7	9. 30 a. m.	5. 80	9. 45 a. m.	5. 40	....	.. .	3. 30 p. m.	1. 35	4. 30 p. m.	1. 70	....	......
8	10. 15 a. m.	6. 00	10. 45 a. m.	5. 70	....	....	4. 15 p. m.	1. 55	5. 15 p. m.	1. 90	....	......
9	10. 45 a. m.	5. 65	11. 00 a. m.	5. 40	....	....	....	.....	5. 45 a. m.	1. 80	....	......
10	11. 45 a. m.	5. 95	12. 30 p. m.	5. 50	....	....	5. 45 a. m.	1. 25	6. 45 a. m.	1. 40	....	......
10	....	....	....	...	....	....	6. 00 p. m.	1. 80	....	....	....	......
11	12. 30 p. m.	5. 80	1. 30 p. m.	5. 40	....	....	6. 15 a. m.	1. 40	....	....	....	......
13	2. 45 p. m.	5. 65	3. 45 p. m.	5. 40	....	....	8. 15 a. m.	1. 40	9. 00 a. m.	1. 70	....	......
14	4. 00 p. m.	6. 10	4. 30 p. m.	5. 70	....	....	9. 30 a. m.	1. 20	10. 15 a. m.	1. 60	....	......
15	5. 00 p. m.	6. 35	5. 45 p. m.	5. 90	....	....	10. 45 a. m.	1. 50	11. 30 a. m.	1. 80	....	......
16	5. 45 a. m.	5. 60	6. 00 a. m.	5. 30	....	....	12. 00 m.	1. 15	12. 45 p. m.	1. 70	....	......
16	5. 45 p. m.	6. 05	6. 30 p. m.	5. 60	....	....	....	......	....	....	....	......
17	6. 15 a. m.	5. 50	6. 45 a. m.	5. 10	....	....	1. 00 p. m.	0. 70	1. 30 p. m.	1. 50	....	......
17	6. 30 p. m.	5. 65	....	....	....	....	....	....	....	....	....	......
18	7. 00 a. m.	5. 50	8. 00 a. m.	5. 10	....	....	1. 30 p. m.	0. 75	2. 45 p. m.	1. 30	....	......
20	8. 30 a. m.	5. 70	9. 15 a. m.	5. 30	....	....	3. 00 p. m.	0. 95	4. 15 p. m.	1. 55	....	......
21	9. 15 a. m.	5. 50	10. 00 a. m.	5. 20	....	....	3. 45 p. m.	1. 10	4. 45 p. m.	1. 60	....	......
22	10. 15 a. m.	5. 25	10. 45 a. m.	4. 90	....	....	4. 15 p. m.	1. 25	5. 30 p. m.	1. 60	....	......
23	....	....	11. 30 a. m.	5. 00	....	....	4. 45 p. m.	1. 55	6. 15 p. m.	1. 60	....	......
24	11. 30 a. m.	5. 25	12. 15 p. m.	4. 90	....	....	5. 30 p. m.	2. 10	6. 15 a. m.	1. 70	....	......
25	12. 15 p. m.	5. 25	1. 15 p. m.	4. 90	....	....	6. 00 a. m.	1. 95	7. 00 a. m	1. 90	....	......
25	....	....	....	....	....	....	6. 15 p. m.	2. 35	....	....	....	......
27	2. 00 p. m.	5. 05	3. 00 p. m.	4. 90	....	....	7. 30 a. m.	2. 10	8. 30 a. m.	2. 10	....	......
28	2. 30 p. m.	5. 10	3. 45 p. m.	4. 90	....	....	8. 15 a. m.	2. 20	9. 30 a. m.	2. 40	....	......
29	3. 45 p. m.	5. 00	4. 30 p. m.	4. 80	....	....	9. 30 a. m.	1. 90	10. 15 a. m.	2. 00	....	......
30	5. 00 p. m.	5. 10	5. 45 p. m.	4. 80	....	....	10. 15 a. m.	1. 40	11. 15 a. m.	1. 69	....	......

OCTOBER, 1880.

1	5. 30 p. m.	5. 50	6. 15 p. m.	5. 20	....	....	11. 15 a. m.	1. 35	12. 15 p. m.	1. 70	....	......
2	6. 00 a. m.	5. 50	6. 30 a. m.	5. 20	....	....	12. 00 m.	1. 35	11. 30 p. m.	1. 80	....	......
4	7. 30 a. m.	5. 85	8. 15 a. m.	5. 50	....	....	2. 00 p. m.	0. 90	3. 00 p. m.	1. 70	....	......
5	8. 00 a. m.	6. 00	9. 00 a. m.	5. 60	....	....	2. 30 p. m.	0. 90	4. 00 p. m.	1. 60	....	......
6	9. 00 a. m.	6. 00	9. 30 a. m.	5. 50	....	....	3. 15 p. m.	0. 90	4. 45 p. m.	1. 60	....	......
7	9. 45 a. m.	6. 05	10. 30 a. m.	5. 60	....	....	4. C0 p. m.	1. 25	5. 15 p. m.	1. 70	....	......
8	10. 30 a. m.	6. 45	11. 30 a. m.	5. 90	....	....	4. 45 p. m.	1. 85	5. 45 p. m.	2. 20	....	......
9	11. 30 a. m.	6. 65	12. 15 p. m.	6. 30	....	....	5. 45 p. m.	2. 10	6. 00 a. m.	2. 00	....	......
11	1. 30 p. m.	6. 10	2. 30 p. m.	5. 70	1. 00 p. m.	5. 80	7. 30 a. m.	1. 80	8. 15 a. m.	2. 00	....	......
12	2. 45 p. m.	6. 00	3. 30 p. m.	5. 60	2. 00 p. m.	5. 60	8. 45 a. m.	1. 50	9. 30 a. m.	1. 90	....	......
13	3. 45 p. m.	6. 40	4. 15 p. m.	6. 00	3. 00 p. m.	6. 30	9. 30 a. m.	1. 60	10. 45 a. m.	1. 80	....	......
14	4. 30 p. m.	6. 25	5. 15 p. m.	5. 80	4. 00 p. m.	5. 00	10. 45 a. m.	1. 75	11. 30 a. m.	2. 10	....	......
15	5. 15 a. m.	6. 00	5. 45 p. m.	5. 60	4. 45 p. m.	5. 50	11. 45 a. m.	1. 55	12. 45 p. m.	2. 00	....	......
16	5. 45 a. m.	6. 05	6. 30 a. m.	5. 70	....	....	12. 30 p. m.	1. 30	1. 45 p. m.	1. 90	....	......
18	7. 30 a. m.	5. 35	8. 00 a. m.	5. 10	....	....	2. 00 p. m.	0. 95	3. 00 p. m.	1. 50	....	......
19	8. 00 a. m.	5. 65	8. 45 a. m.	5. 10	7. 15 a. m.	5. 50	2. 30 p. m.	1. 15	3. 30 p. m.	1. 50	....	......
20	9. 00 a. m.	5. 50	9. 30 a. m.	5. 10	8. 15 a. m.	5. 30	3. 15 p. m.	1. 20	4. 30 p. m.	1. 60	....	......
21	9. 30 a. m.	5. 50	10. 00 a. m.	5. 20	9. 00 a. m.	5. 30	4. 15 p. m.	1. 60	5. 00 p. m.	1. 80	....	......
22	10. 00 a. m.	6. 00	10. 30 a. m.	5. 60	9. 45 a. m.	6. 10	4. 45 p. m.	2. 15	5. 30 p. m.	2. 40	....	......
23	10. 30 a. m.	5. 35	11. 00 a. m.	5. 10	10. 00 a. m.	5. 30	5. 00 p. m.	2. 05	5. 45 p. m.	2. 50	....	......
25	12. 30 p. m.	5 00	1. 15 p. m.	4. 70	12. 00 a. m.	4. 70	6. 00 a. m.	1. 65	7. 00 a. m.	1. 90	....	......
26	1. 00 p. m.	4. 85	1. 45 p. m.	4. 60	12. 30 p. m.	4. 60	6. 45 a. m.	1. 80	8. 00 a. m.	2. 00	....	......
27	2. 00 p. m.	4. 45	2. 30 p. m.	4. 20	1. 15 p. m.	4. 20	8. 00 a. m	1. 65	8. 45 a. m.	1. 80	....	......
28	3. 15 p. m.	4. 40	3. 45 p. m.	4. 20	2. 15 p. m.	4. 30	8. 45 a. m.	1. 40	10. 00 a. m.	1. 60	....	......
29	4. 15 p. m.	5. 40	4. 30 p. m.	5. 10	3. 00 p. m.	5. 30	9. 45 a. m.	1. 75	10. 45 a. m.	1. 70	....	......
30	4. 30 p. m.	5. 20	....	....	....	....	10. 45 a. m.	1. 70	11. 30 a. m.	2. 10	....	......

Record of observations of high and low water—Continued.

NOVEMBER, 1880.

Day of month.	High-water.						Low-water.					
	Smithville.		Federal Point.				Smithville.		Federal Point.			
	Time.		Time.	River side.	Time.	Sea side.	Time.		Time.	River side.	Time.	Sea side.
1	6.30 a. m.	6. 05	7. 00 a. m.	5. 70			12. 45 p. m.	1. 20	1. 30 p. m.	1. 80		
2	7. 00 a. m.	5. 90	7. 45 a. m.	5. 40			1. 30 p. m.	0. 60	2. 30 p. m.	1. 50		
3	7. 45 a. m.	6. 10	8. 30 a. m.	5. 60	7. 00 a. m.	6. 10	2. 30 p. m	0. 80	3. 30 p. m.	1. 60		
4	8. 45 a. m.	6. 40	9. 15 a. m.	6. 00	8. 00 a. m.	6. 50	3. 15 p. m.	0. 85	4. 30 p. m.	1. 50		
5	9. 30 a. m.	5. 95	10. 00 a. m.	5. 50	8. 45 a. m.	5. 80	4 00 p. m	0. 70	5. 15 p. m.	1. 50		
6	10. 30 a. m.	6. 20	11. 00 a. m.	5. 80	9. 30 a. m.	6. 30	4. 45 p. m	1. 20				
8	12. 30 p. m.	5. 95	1. 00 p. m.	5. 50	11. 15 a. m.	6. 00	6. 00 a. m.	1. 15	7. 30 a. m.	1. 70		
9	1. 30 p. m.	5. 65	2. 00 p. m.	5. 30	12. 45 p. m.	5. 60	7. 15 a. m.	1. 70	8. 15 a. m.	1. 90		
10	2. 30 p. m.	5. 25	3. 00 p. m.	4. 90	1. 45 p. m.	5. 10	8. 00 a. m.	1. 30	9. 00 a. m.	1. 70		
11	3. 15 p. m.	4. 70	4. 00 p. m.	4. 40			9. 15 a. m.	0. 95	10. 00 a. m.	1. 50		
12	4. 15 p. m.	4. 50					10. 30 a. m.	0. 60	11. 15 a. m.	1. 30		
13	4. 45 p. m.	5. 60					11. 30 a. m.	0. 80				
15	6. 15 p. m.	5. 50							1. 45 p. m.	1. 90		
16	6. 45 a. m.	5. 45	7. 15 a. m.	5. 20	6. 30 a. m.	5. 80	1. 45 p. m	0. 90	2. 30 p. m.	1. 60		
17	7. 45 a. m.	5. 30	8. 15 a. m	5. 10	7. 15 a. m.	5. 50	2. 15 p. m.	0. 80	3. 15 p. m.	1. 40		
18	8. 15 a. m.	5. 30	9. 00 a. m.	5. 10	7. 45 a. m.	5. 10	3. 15 p. m.	0. 65	4. 00 p. m.	1. 40		
19	9. 00 a. m.	5. 40	9. 45 a. m.	5. 20	8. 30 a. m.	5. 70	3 30 p. m.	1. 40	4. 15 p. m.	1. 70		
20	9. 30 a. m.	5. 95	10. 00 a. m.	5. 70	9. 00 a. m.	5. 80	4. 15 p. m.	1. 30				
22	11. 15 a. m.	4. 80	12. 00 m.	4. 60			5. 00 p. m.	1. 45				
23	11. 45 a. m.	4. 85	1. 00 p. m.	4. 60	11. 30 a. m.	5. 30			7. 15 a. m.	1. 50		
24	12. 15 p. m.	4. 70	1. 30 p. m.	4. 60	12. 00 m.	5. 10	6. 45 a. m.	1. 35	7. 45 a. m	1. 60		
25			1. 30 p. m.	4. 30					8. 15 a. m.	1. 70		
26	2. 30 p. m.	4. 30	2. 45 p. m.	4. 20			8. 15 a. m.	1. 20	9. 15 a. m.	1. 50		
27	3. 00 p. m.	4. 25	3. 15 p. m.	4. 10			9. 00 a. m.	1. 25	10. 15 a. m.	1. 50		
29	4. 45 p. m.	4. 20	4. 45 p. m.	4. 00			11. 30 a. m.	0. 75	12. 15 p. m.	1. 30		
30							12. 30 p. m.	0. 80	1. 15 p. m.	1. 40		

DECEMBER, 1880.

Day of month.	High-water.						Low-water.					
	Smithville.		Federal Point.				Smithville.		Federal Point.			
	Time.		Time.	River side.	Time.	Sea side.	Time.		Time.	River side.	Time.	Sea side.
1	6. 45 a. m.	6. 55	7. 15 a. m.	6. 20			1. 15 p. m.	0. 80	2. 30 p. m.	1. 70		
2	7. 30 a. m.	6. 10	8. 00 a. m	5. 80	7. 00 a. m.	5. 90	2. 15 p. m.	0. 55	3. 15 p. m.	1. 40		
3	8. 30 a. m.	6. 45	8. 45 a. m.	6. 00	7. 30 a. m.	6. 70	3. 15 p. m.	0. 60	3. 45 p. m.	1. 50		
4	9. 30 a. m.	6. 55	9. 30 a. m.	6. 10	8. 30 a. m.	6. 10	4. 00 p. m.	0. 75				
6	11. 00 a. m.	5. 65	12. 15 p. m.	5. 50	11. 00 a. m.	5. 90						
7	11. 45 a. m.	4. 85	12. 30 p. m.	4. 80			6. 00 a. m.	0. 35	7. 00 a. m.	0. 80		
8	1. 00 p. m.	4. 75	1. 45 p. m.	4. 90			6. 45 a. m.	1. 10	7. 45 a. m.	1. 75		
9	1. 30 p. m.	4. 55	2. 45 p. m.	4. 30			7. 30 a. m.	0. 65	8. 45 a. m.	1. 20		
10	3. 00 p. m.	4. 50	3. 45 p. m.	4. 30			8. 45 a. m.	0. 80	10. 00 a. m	1. 30		
11	4. 00 p. m.	4. 50	4. 15 p. m.	4. 40			9. 45 a. m.	0. 90	10. 30 a. m.	1. 30		
13	5. 15 p. m.	4. 55					11. 45 a. m.	1. 10	12. 45 p. m.	1. 50		
14	6. 00 a. m.	5. 25	6. 45 a. m.	5. 10			12. 30 p. m.	0. 95	1. 45 p. m.	1. 50		
15	6. 30 a. m.	4. 80	7. 45 a. m.	4. 70			1. 15 p. m.	0. 80	2. 00 p. m.	1. 30		
16	7. 15 a. m.	5. 15	8. 00 a. m.	4. 90			2. 00 p. m.	0. 85	2. 45 p m.	1. 30		
17	7. 45 a. m.	5. 55	8. 45 a. m.	5. 30			2. 30 p. m.	1. 30	3. 15 p. m.	1. 60		
18	8. 30 a. m.	5. 60	9. 30 a. m.	5. 30			3. 15 p. m.	1. 25	4. 00 p. m.	1. 60		
20	8. 00 a. m.	6. 95			8. 00 a. m.	7. 00	4. 30 p. m.	1. 50	4. 30 p. m.	1. 90		
21	10. 30 a. m.	4. 20	11. 15 a. m.	4. 20			4. 45 p. m.	0. 45				
22	11. 30 a. m.	5. 00	11. 30 a. m.	4. 70			5. 00 p. m.	1. 60	6. 30 a. m	1. 40		
23	11. 30 a. m.	4. 95	12. 15 p. m.	4. 80					6. 45 a. m.	2. 00		
24	12. 15 p. m.	5. 00	12. 30 p. m.	4. 70					10. 45 a. m.	1. 70		
27	3. 15 p. m.	4.85					9. 45 a. m.	1. 45				
28	4. 45 p. m.	5. 25	5. 00 p. m	5. 10			10. 45 a. m.	1. 70	11. 45 a. m.	2. 10		
29	4. 30 p. m	4. 70	5. 15 p. m.	4. 50	8. 45 a. m.	4. 90	11. 45 a. m.	1. 85	12. 30 p. m.	1. 90	10. 45 a. m.	1. 30
30			6. 45 a. m.	5. 30	4. 45 a. m.	5. 10	1. 15 p. m.	0. 60	2. 00 p. m.	1. 30	12. 45 p. m.	—0. 10
31	7. 15 a. m.	5. 95	7. 30 a. m.	5. 60			2. 00 a. m.	0. 30	2. 45 p. m.	1. 20	1. 00 p. m.	0. 10

Record of observations of high and low water—Continued.

JANUARY, 1881.

Day of month.	High-water.						Low-water.					
	Smithville.		Federal Point.				Smithville.		Federal Point.			
	Time.		Time.	River side.	Time.	Sea side.	Time.		Time.	River side.	Time.	Sea side.
1	7.45 a. m.	5.90	8.30 a. m.	5.40	7.00 a. m.	5.80	3.00 p. m.	0.25	....	..	....	......
3	9.45 a. m.	5.90	10.30 a. m.	5.40	8.45 a. m.	5.80	4.15 p. m.	0.80	5.15 p. m.	1.20	3.30 p. m.	0.00
4	10.30 a. m.	5.65	11.00 a. m.	5.80	9.15 a. m.	5.60	5.00 p. m.	0.50	....	....	4.15 p. m.	0.30
5	11.30 a. m.	5.35	12.30 p. m.	5.00	10.30 a. m.	5.30	....	......	6.45 a. m.	1.30	4.00 p. m.	0.80
6	12.15 p. m.	4.55	1.00 p. m.	4.60	12.00 m.	4.80	....	......	7.00 a. m.	1.80	....	......
7	12.45 p. m.	4.20	1.30 p. m.	4.10	12.30 p. m.	4.10	7.30 a. m.	0.90	8.15 a. m.	1.40	7.15 a. m.	1.00
8	2.15 p. m.	4.10	2.15 p. m.	3.80	1.15 p. m.	4.60	8.00 a. m.	1.25	9.00 a. m.	1.60	7.45 a. m.	1.80
10	4.00 p. m.	3.95	4.45 p. m.	4.00	2.45 p. m.	3.60	9.45 a. m.	1.65	11.30 a. m.	2.00	8.45 a. m	1.30
11	5.15 p. m.	4.85	....	..	4.30 p. m.	5.50	11.30 a. m.	1.45	12.15 p. m.	1.80	10.45 a. m.	1.70
12	....	....	6.45 a. m.	4.70	....	....	11.45 a. m.	1.10	12.45 p. m.	1.60	11.00 a. m.	1.30
13	6.15 a. m.	5.15	7.15 a. m.	5.20	....	....	12.45 p. m.	1.15	2.00 p. m.	1.70	12.30 p. m.	1.00
14	7.15 a. m.	5.00	8.00 a. m.	5.00	....	....	1.30 p. m.	1.10	2.45 p. m.	1.60	1.15 p. m.	0.70
15	8.15 a. m.	5.35	8.30 a. m	5.30	7.00 a. m.	5.50	2.15 p. m.	1.00	3.00 p. m.	1.70	1.30 p. m.	1.20
17	8.30 a. m.	5.30	9.15 a. m.	5.30	8.30 a. m	5.10	3.00 p. m.	1.00	4.15 p. m.	1.70	2.45 p. m.	0.80
18	9.15 a. m.	5.25	10.00 a. m.	5.20	9.15 a. m.	5.20	3.45 p. m.	0.80	4.45 p. m.	1.60	3.15 p. m.	0.80
19	9.45 a. m.	5.40	10.45 a. m.	5.30	9.30 a. m.	5.20	4.00 p. m.	1.10	5.15 p. m.	1.70	3.45 p. m.	0.90
20	10.15 a. m.	5.35	11.30 a. m.	5.30	10.15 a. m.	5.30	4.30 p. m.	1.50	5.30 p. m.	2.10	4.15 p. m.	1.50
21	11.00 a. m.	5.00	12.15 p. m.	5.10	11.15 a. m.	4.70	5.15 p. m.	1.15	....	....	4.45 p. m.	0.60
22	11.45 a. m.	4.50	12.45 p. m.	4.50	11.30 a. m.	4.00	7.15 a. m.	1.50	....	....	....	......
24	1.45 p. m.	3.95	2.15 p. m.	3.90	12.45 p. m.	3.80	7.45 a. m.	1.00	9.15 a. m.	1.40	8.30 a. m.	1.30
25	2.30 p. m.	4.05	3.15 p. m.	4.10	1.30 p. m.	3.80	8.45 a. m.	1.10	9.45 a. m.	1.50	9.30 a. m.	1.00
26	4.15 p. m.	4.30	5.00 p. m.	4.30	3.15 p. m.	3.60	10.00 a. m.	0.80	11.15 a. m.	1.50	10.00 a. m.	0.60
27	5.00 p. m.	4.30	5.30 p. m.	4.20	5.15 p. m.	4.20	11.15 a. m.	0.20	12.30 p. m.	1.20	10.45 a. m.	—0.20
28	6.15 p. m.	4.90	....	....	5.45 p. m.	4.60	12.15 p. m.	0.20	1.45 p. m.	1.10	11.45 a. m.	0.20
29	6.45 a. m.	5.70	7.45 a. m.	5.50	....	....	1.45 p. m.	—0.10	2.45 p. m.	1.10	1.00 a. m.	—0.40
31	8.30 a. m.	5.60	9.15 a. m.	5.30	8.30 a. m.	5.30	3.00 p. m.	—0.10	4.30 p. m.	1.10	2.30 a. m.	—0.50

FEBRUARY, 1881.

Day of month.	High-water.						Low-water.					
	Smithville.		Federal Point.				Smithville.		Federal Point.			
	Time.		Time.	River side.	Time.	Sea side.	Time.		Time.	River side.	Time.	Sea side.
1	9.15 a. m.	5.90	10.15 a. m.	5.50	8.45 a. m.	5.70	4.00 p. m.	0.25	5.00 p. m.	1.30	3.15 p. m.	—0.30
2	10.15 a. m.	5.50	11.30 a. m.	5.30	9.15 a. m.	5.90	4.30 p. m.	0.30	5.15 p. m.	1.30	4.00 p. m.	0.40
3	10.45 a. m.	5.25	11.45 a. m	5.00	10.30 a. m.	5.50	5.15 p. m.	0.65	....	...	4.30 p. m.	0.60
4	11.45 a. m.	4.65	12.30 p. m.	4.50	11.30 a. m.	4.80	6.15 a. m.	0.80	6.45 a. m.	1.50	4.30 p. m.	0.80
5	12.30 p. m.	4.30	1.00 p. m.	4.20	12.15 p. m.	4.30	6.45 a. m.	1.10	7.45 a. m.	1.50	....	......
7	2.30 p. m.	4.10	3.15 p. m.	3.80	2.00 p. m.	4.30	8.30 a. m.	1.70	10.00 a. m.	1.70	9.30 a. m.	2.10
8	3.00 p. m.	4.40	4.00 p. m.	3.90	2.30 p. m.	4.80	9.30 a. m.	1.80	10.30 a. m.	1.70	9.30 a. m.	1.80
9	5.00 p. m.	4.15	5.00 p. m.	4.00	4.15 p. m.	3.90	10.30 a. m.	1.70	11.15 a. m.	1.80	10.15 a. m.	1.60
10	5.15 p. m.	3.80	6.00 p. m.	3.80	5.15 p. m.	3.80	11.30 a. m.	1.00	12.45 p. m.	1.40	11.15 a. m.	1.00
11	5.45 p. m.	4.20	....	...	5.30 p. m.	3.90	12.00 m.	0.80	1.00 p. m.	1.30	11.45 a. m.	0.80
12	6.15 a. m.	5.10	6.45 a. m.	5.10	....	....	1.30 p. m.	0.60	1.30 p. m.	1.40	12.30 p. m.	0.10
14	7.30 a. m.	4.40	8.30 a. m.	4.20	7.15 a. m.	4.30	2.00 p. m.	0.10	3.15 p. m.	0.90	1.30 p. m.	0.20
15	8.00 a. m.	4.80	9.00 a. m.	4.60	7.45 a. m.	4.80	2.45 p. m.	0.35	3.30 p. m.	1.00	1.45 p. m.	0.60
16	8.15 a. m.	4.40	9.30 a. m.	4.40	9.00 a. m.	4.30	3.00 p. m.	0.00	4.00 p. m.	1.00	2.30 p. m.	—0.10
17	9.30 a. m.	4.75	10.00 a. m.	4.50	9.15 a. m.	4.70	3.30 p. m.	0.35	4.45 p. m.	1.10	3.00 p. m.	0.60
18	10.15 a. m	4.65	10.45 a. m.	4.50	9.30 a. m.	4.70	4.15 p. m.	0.45	5.00 p. m.	1.20	3.30 p. m.	0.30
19	10.45 a. m.	4.20	11.15 a. m.	4.20	10.00 a. m.	3.80	4.45 p. m.	0.40	5.30 p. m.	1.20	4.15 p. m.	0.20
21	12.30 p. m.	4.05	1.15 p. m.	4.00	12.15 p. m.	3.80	6.30 a. m.	1.20	8.00 a. m.	1.50	....	..
22	1.00 p. m.	4.00	2.00 p. m.	3.90	1.00 p. m.	4.00	7.30 a. m.	0.90	8.30 a. m.	1.40	7.30 a. m.	1.00
23	3.00 p. m.	4.15	....	....	....	....	8.30 a. m.	1.10	....		....	......
24	3.45 p. m.	4.55	4.45 p. m.	4.40	2.45 p. m.	4.30	10.15 a. m.	0.80	11.15 a. m.	1.40	9.30 a. m.	1.30
25	....	....	....	....	4.00 p. m.	3.70	....	......	12.30 p. m.	1.10	10.30 a. m.	—0.10
26	5.45 p. m.	4.90	....	...	4.45 p. m.	4.70	12.00 m.	0.10	1.15 p. m.	0.90	11.30 a. m.	0.00
28	7.30 a. m.	5.70	8.00 a. m.	5.40	7.00 a. m.	5.10	2.00 p. m.	0.15	....	....	1.15 p. m.	—0.10

Record of observations of high and low water—Continued.

MARCH, 1881.

Day of month.	High-water.						Low-water.					
	Smithville.		Federal Point.				Smithville.		Federal Loint.			
	Time.		Time.	River side.	Time.	Sea side.	Time.		Time.	River side,	Time.	Sea side.
1	8.00 a. m.	5.15	9.00 a. m.	4.90	7.45 a. m.	4.80	2.45 p. m.	0.20	3.30 p. m.	0.90	2.30 p. m.	—0.70
2	9.00 a. m.	5.25	9.30 a. m.	4.90	8.15 a. m.	5.00	3.15 p. m.	0.15	4.15 p. m.	1.00	2 45 p m.	—0.10
3	9.45 a. m.	5.50	10.00 a. m.	5.10	9.00 a. m.	5.60	3.45 p. m.	0.85	4.30 p. m.	1.40	3.00 p. m.	0.80
4	10.30 a m.	4.60	11.15 a. m.	4.60	9.45 a. m.	4.30	4.45 p. m.	0.45	5.30 p. m.	1.40	4.15 p. m	0.00
5	11.30 a. m.	4.30	12.15 p. m.	4.30	11.00 a. m.	3.70	5.30 p. m.	0.50	...	...	...	...
7	12.45 p. m.	4.10	1.30 p. m.	4.00	11.45 a. m.	4.00	6.45 a. m.	1.40	7.45 a. m.	1.70	...	...
8	2.00 p. m.	4.25	2.30 p. m.	4.10	1.00 p. m.	4.10	7.45 a. m.	1.80	8.30 a. m	1.90	7.15 a. m.	1.70
9	2.30 p. m.	4.00	3.15 p. m.	3.80	1.30 p. m.	3.60	9.30 a. m.	1.70	10.15 a. m.	1.70	9.15 a. m.	1.20
10	3.15 p. m.	4.15	4.00 p. m.	4.00	2.45 p. m.	3.80	10.00 a. m.	1.30	10.45 a. m.	1.60	9.45 a. m.	1.10
11	4.15 p. m.	4.40	5.00 p. m.	4.70	3.30 p. m.	4.20	10.30 a. m.	1.65	11.15 a. m.	1.70	10.15 a. m.	1.40
12	5.15 p. m.	4.40	...	...	...	...	11.00 a. m.	1.50	12.15 p. m.	1.70	10.45 a. m.	1.30
14	6.45 a. m.	4.60	7.15 a. m.	4.50	7.00 a. m.	4.50	12.45 p. m.	0.70	1.15 p. m.	1.40	12.15 p. m.	0.60
15	7.15 a. m.	5.05	7.30 a. m.	4.90	7.00 a. m.	5.10	1.15 p. m.	0.80	2.00 p m.	1.30	1.15 p. m.	0.80
16	7.45 a. m.	5.00	8.00 a. m.	4.80	7.00 a. m.	4.80	2.00 p. m.	0.50	2.45 p. m.	1.20	1.30 p. m.	0.50
17	8.30 a. m.	5.45	8.45 a. m.	5.10	7.30 a. m.	5.30	3.00 p. m.	0.75	3.45 p. m.	1.50	1.45 p. m.	0.50
18	9.15 a. m.	5.15	9.30 a. m.	4.90	8.30 a. m.	4.90	3.30 p. m.	0.70	4.15 p. m,	1.30	2.45 p. m.	0.60
19	10.15 a. m.	5.75	10.30 a. m.	5.50	9.15 a. m.	5.70	4.15 p. m.	1.30	...	...	3.30 p. m.	0.90
21	11.30 a. m.	4.50	12.00 m.	4.80	10.45 a. m.	4.60	5.30 p. m.	0.95	6.15 p. m.	1.60	4.45 p. m.	0.80
22	12.00 m.	4.80	12.30 p. m.	4 70	11.30 a. m.	5.10	6.30 a. m.	1.35	7.00 a. m.	1.80	5.30 p. m.	0.70
22	...	...	...	...	...	...	5.30 p. m.	1.10	...	...	...	...
23	1.30 p. m.	4.70	1.45 p. m.	4.60	12.30 p. m.	4.60	7.30 a. m.	1.20	8.00 a. m.	1.70	7.00 a. m.	1.30
24	2.30 p. m.	4.75	3.30 p. m.	4.60	1.45 p. m.	4.50	8.15 a. m.	1.05	9.30 a. m.	1.60	7.30 a. m.	1.20
25	3.30 p. m.	4.70	4.30 p. m.	4.60	2.30 p. m.	4.30	9.45 a. m.	0 60	10.30 a. m.	1.30	9.30 a. m.	0.40
26	4.15 p. m.	4.20	...	...	...	...	11.00 a. m.	0.45	12.00 m.	1.30	10.45 a. m.	—0.10
28	6.00 a. m.	5.35	7.00 a. m.	5.00	6.00 p. m.	5.10	12.30 p. m.	0.20	1.30 p. m.	1.00	11.45 a. m.	0.10
28	6.15 p. m.	5.35	...	...	...	...	...	...	...	...	...	...
29	6.45 a. m.	5.10	7.30 a. m	4.80	...	...	1.15 p. m.	0.00	2.15 p. m.	1.00	12.30 p. m.	—0.20
30	7.15 a. m.	5.10	7.45 a. m.	4.90	6.45 a. m.	4.90	2.30 p. m.	0.10	3.30 p. m.	1.10	1.45 p. m.	—0.10
31	8.15 a. m.	3.95	9.15 a. m.	3.90	7.45 a. m.	3.60	2.45 p. m.	0.30	3.30 p. m.	0.70	2.00 p. m.	—0.80

APRIL, 1881.

Day of month.	High-water.						Low-water.					
	Smithville.		Federal Point.				Smithville.		Federal Loint.			
	Time.		Time.	River side.	Time.	Sea side.	Time.		Time.	River side,	Time.	Sea side.
1	9.30 a. m.	4.55	9.45 p. m.	4.70	9.00 a. m.	4.50	3.30 p. m.	—0.10	5.00 a. m.	1.10	3.00 a. m.	—1.00
2	10.30 a. m.	3.45	10.30 p. m.	3.60	9.30 a. m.	3.50	4 15 p. m.	—0.20	5.15 a. m.	0.80	3.15 a. m.	—0.20
4	11.30 a. m.	3.80	11.45 p. m.	3.80	11.00 a. m	3.60	6.00 p. m.	0.45	6.30 a. m.	1.50	5.15 a. m.	0.30
5	12.30 p. m	3.75	1.00 p. m.	3.60	11.30 a. m.	3.70	5.45 a. m.	1.05	6.30 a. m.	1.30	6.15 a. m.	1.10
6	1.00 p. m.	3.50	1.30 p. m.	3.40	12.00 m.	3.50	6.45 a. m.	1.20	8.00 a. m.	1.30	7.00 a. m.	1.30
7	1.45 p. m.	3.80	2.15 p. m.	3.50	1.00 p. m.	3.60	7.45 a. m.	1.15	8.45 a. m.	1.20	7.45 a. m.	1.30
8	2.15 p m.	4.35	2.45 p. m.	4.30	1.30 p. m.	4.80	8.00 a. m.	1.75	9.00 a. m.	1.80	7.45 a. m.	2.00
9	4.00 p. m.	4.40	4.00 p. m.	4.10	2.45 p. m.	4.10	9.30 a. m.	1.40	10.30 a. m.	1.50	9.15 a. m.	1.30
11	5.30 p. m.	5.00	5.45 p. m.	4.70	4.30 p. m.	5.10	11.30 a. m.	0.75	12.15 p. m.	1.20	10.00 a. m.	0.90
12	6.00 p. m.	4.60	6.00 p. m.	4.70	5.15 p. m.	5.00	12.00 a. m.	0.50	12.30 p. m.	1.10	11.15 a. m.	0.50
13	6.30 p. m.	4.60	7.15 a. m.	4.50	6.00 p. m.	4.60	12.45 p. m.	0.40	1.30 p. m.	1.20	12.15 p. m.	—0.10
14	7.30 p. m.	4.95	7.30 a. m.	4.60	6.15 p. m.	4.80	1.00 p. m.	0.55	1.45 p. m.	1.30	12.00 m.	1.10
15	7.45 p. m.	5.00	8.30 a. m.	4.90	7.30 a. m.	5.10	2.15 p. m.	0.70	2.45 p. m.	1.40	1.15 p. m.	0.50
16	8.30 p. m.	4.80	9.15 a. m.	4.70	7.45 a. m.	4.80	3.00 p. m.	0.30	4.00 p. m.	1.10	2.00 p. m.	—0.30
18	10.30 p. m.	4.20	10.45 a. m.	4.10	9.45 a. m.	3.80	4.30 p. m.	0.30	5.15 p. m.	1.10	4.00 p. m.	—0.10
19	11.00 p. m.	4.25	11.30 a. m.	4.20	10.30 a. m.	4.20	5.00 p. m.	0.30	6.30 a. m.	1 20	4.30 p. m.	0.60
19	...	...	...	...	...	...	...	...	6.00 p. m.	1.10	...	...
20	12.15 p. m.	4.70	12.45 p. m.	4.50	11.30 a. m.	4.50	6.30 a. m.	1.10	...	...	...	...
21	1.15 p. m.	5.00	1.45 p. m.	4,70	12.30 p. m.	5.10	7.15 a. m.	1.10	8.15 a. m.	1.50	7.00 a. m.	1.50
22	2.45 p. m.	5.00	3.00 p. m.	4.80	2.15 p. m.	4.80	8.15 a. m.	1.15	9.15 a. m.	1.60	8.00 a. m.	1.10
23	3.30 p. m.	5.00	4.15 p. m.	4.70	2.45 p. m.	4.90	9.30 a. m.	0.70	10.30 a. m.	1.30	9.00 a. m.	0.60
25	5.15 p. m.	5.15	6.00 p. m.	4.80	4.45 p. m.	4.90	11.15 a. m.	0.15	12.00 m.	1.00	10.30 a. m.	0.00
26	5.45 a. m.	4.65	6.30 p. m.	4.40	5.30 p. m.	5.10	12.15 p. m.	0.00	1.00 p. m.	0.90	11.15 a. m.	—0.10
26	6.00 p. m.	5.40	...	...	...	...	...	...	...	...	...	...
27	6.15 a m.	4.65	7.00 a. m.	4.30	6.15 p. m.	5.10	12.45 p. m.	0.00	1.30 p. m.	1.00	12.00 m.	0.00
27	6.45 p. m.	5.30	...	...	...	...	...	...	...	...	...	...
28	7.00 a. m.	4.55	7.45 a. m.	4.30	6.30 a. m.	4.50	1.30 p. m.	0.10	2.30 p. m.	0.90	1.00 p. m.	0.10
29	7.45 a. m.	4.45	8.15 a. m	4.20	7.00 a. m.	4.30	2.00 p. m.	0.10	3.00 p. m.	0.90	1.30 p. m.	0.10
30	8.30 a. m.	4.20	9.00 a. m.	3.60	8.15 a. m.	4.30	2.30 p. m.	0.10	3.15 p. m.	0.80	1.15 p. m.	0.60

Record of observations of high and low water—Continued.

MAY, 1881.

Day of month.	High-water.						Low-water.					
	Smithville.		Federal Point.				Smithville.		Federal Point.			
	Time.		Time.	River side.	Time.	Sea side.	Time.		Time.	River side.	Time.	Sea side.
2	9. 45 a. m.	3. 75	10. 30 a. m.	3. 60	9. 15 a. m.	3. 70	3. 45 p. m.	0. 30	4. 30 p. m.	1. 00	3. 15 p. m.	0. 60
3	11. 00 a. m.	3. 60	11. 30 a. m.	3. 50	10. 00 a. m.	3. 60	4. 45 p. m.	0. 50	5. 15 p. m.	1. 00	4. 00 p. m.	0. 60
4	11. 45 a. m.	3. 80	12. 15 p. m.	3. 70	11. 30 a. m.	4. 00	5. 30 a. m.	0. 80	6. 30 p. m.	1. 20	4. 30 p. m.	1. 60
4	....	....	....	....	....	....	5. 15 p. m.	1. 20	....	....	....	......
5	12. 45 p. m.	4. 20	1. 15 p. m.	4. 00	11. 45 a. m.	4. 10	6. 30 p. m.	1. 40	7. 15 a. m.	1. 60	6. 00 a. m.	1. 60
6	1. 15 p. m.	4. 25	1. 30 p. m.	4. 10	12. 30 p. m	4. 30	7. 00 a. m.	1. 50	8. 00 a. m.	1. 60	6. 45 a. m.	1. 60
9	4. 00 p. m.	4. 60	4. 45 p. m.	4. 40	3. 15 p. m.	4. 50	9. 45 a. m.	1. 00	10. 30 a. m.	1. 30	8. 30 a. m.	1. 00
10	5. 00 p. m.	4. 80	5. 30 p. m.	4. 60	4. 00 p. m.	4. 70	10. 30 a. m.	0. 55	11. 30 a. m.	1. 10	1. 00 p. m.	0. 60
11	5. 15 p. m.	4. 20	6. 00 p. m.	4. 70	4. 45 p. m.	5. 00	11. 15 a. m.	0. 20	12. 45 p. m.	0. 90	10. 45 a. m.	0. 30
11	5. 45 p. m.	5. 05	....	....	....	....	....	....	....	....	....	......
12	5. 45 a. m.	4. 20	6. 30 a. m.	4. 00	5. 15 p. m.	5. 10	12. 00 m.	—0. 10	1. 00 p. m.	0. 80	11. 30 a. m.	0. 00
12	6. 15 p. m.	5. 20	....	....	....	....	....	....	....	....	....	......
13	6. 45 a. m.	4. 20	7. 15 a. m.	4. 00	6. 15 p. m.	5. 70	12. 45 p. m.	—0. 10	1. 45 p. m.	0. 70	12. 00 m.	0. 10
13	7. 15 p. m.	5. 65	....	....	....	....	....	....	....	....	....	......
14	7. 30 a. m.	4. 75	8. 00 a. m.	4. 50	6. 45 a. m.	4. 70	1. 45 p. m	0. 30	2. 00 p. m.	1. 00	....	......
16	9. 15 a. m.	5. 05	9. 45 a. m.	4. 70	8. 45 a. m.	5. 00	3. 30 p. m.	0. 55	4. 30 p. m.	1. 20	2. 30 p. m.	0. 40
17	10. 00 a. m.	5. 35	10. 45 a. m.	4. 90	9. 15 a. m.	5. 30	4. 15 p. m.	0. 95	5. 15 p. m.	1. 50	3. 30 p. m.	0. 80
18	11. 00 a. m.	5. 45	11. 15 a. m.	5. 00	10. 00 a. m.	5. 30	5. 15 p. m.	1. 00	6. 00 p. m.	1. 60	4. 00 p. m.	1. 30
19	11. 45 a. m.	5. 30	12. 30 p. m.	5. 00	11. 15 a. m.	5. 30	6. 00 a. m.	1. 10	7. 00 a. m.	1. 70	5. 30 p. m.	1. 30
20	1. 00 p. m.	5. 25	1. 30 p. m.	5. 00	12. 15 p. m.	5. 30	7. 00 a. m.	1. 05	8. 00 a. m.	1. 60	6. 00 a. m.	1. 00
21	1. 45 p. m.	5. 20	2. 15 p. m.	4. 90	1. 30 p. m.	5. 30	8. 00 a. m.	0. 70	9. 00 a. m	1. 30	7. 15 a. m.	0. 70
23	4. 00 p. m.	5. 50	4. 30 p. m.	5. 10	3. 00 p. m	5. 50	9. 45 a. m.	0. 50	10. 45 a. m.	1. 20	8. 45 a. m.	0. 60
24	4. 45 p. m.	6. 00	5. 30 p. m.	5. 50	3. 30 p. m.	5. 80	10. 30 a. m.	0. 75	10. 30 a. m.	1. 30	9. 45 a. m.	1. 30
25	5. 30 p. m.	6. 00	6. 00 p. m.	5. 60	5. 15 p. m.	6. 00	11. 30 a. m.	0. 90	12. 15 p. m.	1. 50	10. 30 a. m.	1. 20
26	6. 15 a. m.	5. 15	6. 30 a. m.	4. 90	5. 30 a. m.	5. 10	12. 30 p. m.	1. 10	1. 00 p. m.	1. 60	....	......
26	6. 30 p. m.	6. 25	....	....	5. 15 p. m.	6. 30	....	....	....	....	....	......
27	6. 45 a. m.	5. 50	7. 00 a. m.	5. 10	6. 30 p. m.	6. 50	1. 00 p. m.	1. 40	1. 30 p. m.	1. 80	....	......
27	7. 00 p. m.	6. 60	....	....	....	....	....	....	....	....	....	......
28	7. 45 a. m.	5. 20	8. 00 a. m.	4. 90	6. 45 a. m.	5. 10	1. 45 p. m.	1. 10	2. 15 p. m.	1. 70	12. 45 p. m.	1. 20
30	9. 00 a. m.	4. 55	9. 30 a. m.	4. 40	8. 15 a. m.	4. 50	3. 00 p. m.	1. 20	4. 00 p. m.	1. 60	2. 00 p. m.	1. 20
31	9. 30 a. m.	4. 50	10. 00 a. m.	4. 30	8. 30 a. m.	4. 50	3. 45 p. m.	1. 20	4. 15 p. m.	1. 60	2. 45 p. m.	1. 30

LETTER OF COLLECTOR OF CUSTOMS AT WILMINGTON, NORTH CAROLINA.

CUSTOM-HOUSE, WILMINGTON, N. C.,
Collector's Office, July 5, 1881.

SIR: Complying to your request of the 4th instant, I herewith furnish you with the amount of customs revenue collections at the port of Wilmington, N. C., for the fiscal year ending June 30, 1881, amounting to $69,359.85.

It is very gratifying to me to be able to state that there has been an increase of about 25 per cent. over the collections for the fiscal year ending June 30, 1880.

Very respectfully,

W. P. CANNADAY,
Collector.

HENRY BACON, Esq.,
Assistant Engineer.

COMMERCIAL STATISTICS.

CHAMBER OF COMMERCE,
Wilmington, N. C., June 30, 1881.

COLONEL: I herewith forward statistics relating to the ocean commerce of this port, foreign and coastwise, for past five years.

You will observe the increase is a fair per centage in the aggregate, but largest in the article of cotton foreign, also lumber foreign and coastwise. Both of these will largely increase in the future, especially when 16 feet depth at low-water is obtained.

Owners of large-class foreign steamships and sailing-vessels have expressed determination to run their ships to this port. First-class steamers between this and coastwise ports are in contemplation, and railroad connections with the far West will be consummated as soon as we have desired depth.

I trust Congress will, at its next session, appropriate sufficient means to complete the project of obtaining 16 feet at low-water from Smithville to Wilmington, also continuing operations in Bald-Head Channel to such depth over 16 feet as may be obtainable. This is a work of acknowledged merit, producing results, beneficial to the commerce of the world and in many other manners to our own national government.

With respect, yours, truly,

A. H. VAN BOKELEN,
President Chamber of Commerce.

Lieut. Col. WM. P. CRAIGHILL,
United States Engineer Corps.

Shipments from Port of Wilmington, N. C., of principal articles of export for twelve months ending 31st May, for five years.

	Cotton.	Spirits turpentine.	Rosin.	Tar.	Pitch and turpentine.	Sawed lumber.	Shingles.
	Bales.	*Casks.*	*Barrels.*	*Barrels and cases.*	*Barrels.*	*Feet.*	*Number*
1881.							
Foreign	79, 810	54, 203	444, 754	15, 147	85	16, 053, 615	3, 025, [illegible]
Coastwise	47, 895	29, 950	50, 916	47, 203	12, 197	26, 306, 019	4, 621, 055
Total	127, 705	84, 153	495, 670	62, 350	12, 282	42, 359, 634	7, 647, 0[illegible]
1880.							
Foreign	36, 586	77, 213	472, 792	11, 963	95	9, 315, 580	3, 258, 975
Coastwise	39, 663	28, 987	38, 390	44, 789	12, 457	20, 030, 092	4, 218, 475
Total	76, 249	106, 200	511, 182	56, 752	12, 552	29, 345, 672	7, 577, 450
1879.							
Foreign	64, 431	83, 322	443, 693	24, 517	533	8, 783, 735	2, 613, 105
Coastwise	45, 791	16, 182	66, 265	45, 864	10, 107	9, 494, 220	4, 607, 450
Total	110, 222	99, 504	509, 958	70, 381	10, 640	18, 277, 955	7, 220, 555
1878.							
Foreign	56, 667	91, 312	477, 488	32, 558	1, 393	8, 889, 098	2, 295, [illegible]
Coastwise	68, 370	18, 450	75, 343	31, 388	10, 013	7, 916, 823	4, 552, 300
Total	125, 037	109, 762	552, 831	63, 946	11, 406	16, 805, 921	6, 847, [illegible]
1877.							
Foreign	36, 480	75, 224	389, 518	33, 018	2, 095	8, 918, 741	2, 824, 234
Coastwise	74, 394	22, 597	114, 309	39, 782	10, 107	7, 945, 991	4, 387, 8[illegible]
Total	110, 874	97, 821	503, 827	72, 800	12, 202	16, 864, 732	7, 212, 0[illegible]

In addition to above, a variety of products and manufactures of this and other States make up the valuation of foreign and coastwise shipments for years ending May, 1881, $12,481,330; May, 1880, $10,224,396; May, 1879, $10,644,138. Value of inward cargoes are estimated at $6,000,000 to $8,000,000 annually.

Statement of steamships and sailing vessels, over 60 tons, engaged in ocean commerce only, departing with full cargoes, from the port of Wilmington, N. C., for twelve months preceding the 31st day of May, for five years.

Vessels.	1881.	1880.	1879.	1878.	1877.
To foreign ports	309	317	288	258	224
Tonnage	101, 228	97, 259	91, 684	80, 843	69, 763
To American ports	280	269	252	299	324
Tonnage	125, 974	121, 061	118, 776	123, 558	135, 577
Total vessels	589	536	540	557	551
Total tonnage	227, 202	218, 320	210, 460	204, 401	205, 340

The steady increase of foreign commerce and increased capacity of vessels engaged in same gives evidence of the benefits already gained by what additional depth of waters has been obtained. Assurance of large increase, both foreign and domestic, as soon as depth of 16 feet is obtained from Smithville to city, comes from various quarters.

G 25.

DEEPENING ENTRANCE TO SAINT JEROME'S RIVER, MARYLAND.

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., December 16, 1880.

GENERAL: I received to day, embodied in the letter from your office of December 15, a resolution of the Senate, dated December 13, which is in the following words:

> *Resolved*, That the Secretary of War be requested to furnish to the Senate, at the earliest practicable period, an estimate of the cost of deepening the entrance to Saint Jerome's River, in Maryland, so as to make it an available harbor.

It is supposed the "Saint Jerome's River" mentioned is Saint Jerome's Creek, which empties into Chesapeake Bay about five or six miles north of Point Lookout, at the mouth of the Potomac River.

The resolution of the Senate gives no idea of the character of craft for which the proposed harbor is to be made available. This information is essential in order to a determination of the proper width and depth to be given to the entrance of the creek.

I am informed, however, by the assistant United States Commissioner of Fisheries, in person, that the resolution was introduced in the interest of the Fish Commission.

An examination of the locality was made last summer, under the supervision of the Fish Commission, by Mr. William R. Hutton, a civil engineer of skill and experience.

The estimates submitted below are derived from information based upon his examination, and are believed to be reliable, though only claiming to be approximate. To accomplish the object indicated by the Fish Commissioner and the resolution of the Senate, will require the sum of $6,500.

Very respectfully, your obedient servant,

WM. P. CRAIGHILL,
Major of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. W. R. HUTTON, ASSISTANT ENGINEER.

BALTIMORE, MD., *December* 16, 1880.

COLONEL: I herewith submit an estimate of the cost of opening a channel into Saint Jerome's Creek.

Maj. T. B. Ferguson, fish commissioner of the State of Maryland, informs me that a channel is needed into the south prong of Saint Jerome's Creek, 4 feet deep and 25 feet wide. It will be necessary to make a channel at least 6 feet deep below mean low-water, to enable a dredge to work in it, and also to permit boats to enter at extreme low stages of the water. An estimate is therefore presented for a channel 6 feet deep and 25 feet wide at bottom. But a channel of this width will be too narrow for easy navigation, and I have therefore submitted a supplemental estimate for increasing its width to 40 feet.

The resolution, however, calls for an estimate of the cost of making the creek a safe and practicable harbor. There is deep water (12 to 15 feet) in the mouth of the creek, and deep water inside, although the extent of it is not known with accuracy. But there is a bar off the mouth having but 4 feet at mean low-tide. The creek will be formed a practicable harbor for any vessels which will probably have occasion to use it, by the opening of a channel through the bar to a depth of 9 feet below mean low water, and 100 feet in width.

The material to be excavated in making the smaller channel will be, to some extent mud, but chiefly sand and shells, which may be deposited on one side withour further handling. That upon the bar is altogether sand, which can be removed in scows and deposited in deep water at a very short distance.

ESTIMATE OF THE COST OF OPENING CHANNELS AT SAINT JEROME'S CREEK, CHESAPEAKE BAY.

1. Channel 25 feet wide, 6 feet deep below mean low-water, 13,560 cubic yards of dredging, at 20 cents		$2,712 00
Surveys, superintendence, and contingencies, 15 per cent		401 80
		3,113 80
2. Additional sum to increase the width of channel from 25 feet to 40 feet, 5,068 yards, at 20 cents	$1,013 60	
Add 10 per cent., as above	101 30	1,114 90
		4,228 70
3. Cut through bar opposite the mouth of Saint Jerome's Creek, to give 9 feet at mean low-water, 100 feet wide, 9,900 yards, at 20 cents		1,980 00
Ten per cent. for superintendence and contingencies		198 00
		2,178 00

Respectfully,

WM. R. HUTTON,
Civil Engineer.

Col. W. P. CRAIGHILL,
United States Engineer.

APPENDIX H.

IMPROVEMENT OF THE HARBORS AT WASHINGTON AND GEORGETOWN, DISTRICT OF COLUMBIA, AND AT BRETON BAY AND SAINT JEROME'S CREEK, MARYLAND; OF THE CHANNEL AT MOUNT VERNON, VIRGINIA; OF RAPPAHANNOCK RIVER; OF TRIBUTARIES OF THE LOWER POTOMAC, AND OF CERTAIN RIVERS IN VIRGINIA AND NORTH CAROLINA.

REPORT BY MR. S. T. ABERT, UNITED STATES CIVIL ENGINEER, IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1881, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

UNITED STATES ENGINEER OFFICE,
Washington, D. C., August 10, 1881.

GENERAL: I have the honor to submit herewith my annual report relating to the works of river and harbor improvement under my charge for the fiscal year ending June 30, 1881.

Very respectfully, your obedient servant,

S. T. ABERT,
United States Civil Engineer.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

H 1.

IMPROVEMENT OF HARBORS AT WASHINGTON AND GEORGETOWN, DISTRICT OF COLUMBIA.

HISTORY OF THE IMPROVEMENT.

The improvement of the harbors at Washington and Georgetown, District of Columbia, comprising that part of the Potomac River along the water front of the cities of Washington and Georgetown, was definitely commenced under the direction of the Chief of Engineers, July 11, 1870, when an appropriation of $50,000 was made for the improvement of the Potomac River between the Long Bridge and the city of Georgetown. This appropriation was expended in dredging a channel 200 feet wide and 15 feet deep at low-water through the bar which has existed for a long period and formed the principal obstruction to the navigation. The channel was completed in December, 1871, the improvement having been in the charge of Maj. N. Michler, Corps of Engineers, until November, 1870, when it was transferred to Maj. William P. Craighill, Corps of Engineers.

By act of Congress approved March 5, 1872, a Board of Survey was created in order to prepare a plan for the permanent improvement of Washington and Georgetown harbors.

The plan recommended by this Board, providing for the reclamation of the flats, deepening and widening the Virginia Channel, and the correction of the curvature of the river, has been fully described in previous annual reports, and will be found at length in Senate Mis. Doc. No. 15, forty-second Congress, first session.

On March 3, 1873, an appropriation of $50,000 was made, but was not expended during that year.

In the river and harbor act of June 23, 1874, it was provided that this appropriation be applied to dredging the Virginia Channel, and that the excavated material be deposited so as to conform to the plan of the Board of Survey.

The improvement was transferred to my charge in July, 1874, and during the fiscal year ending June 30, 1875, a channel 200 feet wide and 15 feet deep was dredged through the bar above the Long Bridge and through a bar near Giesborough Point. The balance of the appropriation was applied to the removal of 3 rocks in Georgetown Harbor in 1876, by hired labor. The details of this work are contained in the report of the Chief of Engineers for 1877, part 1, page 351.

The high freshet which occurred November 25, 1877, resulted in large deposits of sediment, reducing the depth to 9 feet at low-water on the bar below Easby's Point.

The river and harbor act of June 18, 1878, appropriated $50,000 for the continuation of the improvement, $20,000 to be expended on the Washington Channel, and $30,000 on the Georgetown Channel. The contractors, Messrs. Brainard & Rice, to whom the contract for dredging was first awarded, after doing a small amount of work, failed, and their contract was annulled, their sureties also having failed to do the work.

The dredging was re-let January 5, 1879, and the new contract awarded to Messrs. George C. Fobes & Co., of Baltimore, Md. Under this contract a channel was dredged along the Washington wharves to a width of 200 feet and depth of 12 to 13 feet at low-water, extending from a point near the Long Bridge to the upper end of the Arsenal Grounds.

This portion of the contract was completed July 9, 1879.

Under the same contract a channel 200 feet wide and 16 feet deep at low-water was dredged through the bar above the Long Bridge in the Georgetown Channel. This portion of the contract was completed April 14, 1880.

The river and harbor act approved March 3, 1879, appropriated $50,000 for this improvement, $20,000 of which was directed to be expended in Washington Channel below the Long Bridge, and $30,000 in Georgetown Harbor and Channel.

As the Georgetown Channel was completed to the dimensions above-named, under the previous appropriation, it was decided not to expend that portion of the appropriation of 1879 designated for Georgetown Harbor and Channel, until the depth over the bar had been materially reduced, and that sum yet remains unexpended.

Under that portion of the appropriation of 1879 designated for Washington Channel, a contract was made with George C. Fobes & Co. for deepening Washington Channel. At the close of this contract, June 3, 1881, the channel for a width of 75 feet next the wharves had been deepened to 15 feet at low-water.

WORK OF THE PAST FISCAL YEAR.—WASHINGTON CHANNEL.

The river and harbor act approved June 14, 1880, appropriated $40,000 for "continuing the improvements, including the removal of rocks."

Under this appropriation specifications were prepared for dredging the Washington Channel, and with a view to subsequently deciding upon the deposition of the dredged material, proposals were invited by public advertisement for depositing it at either of two localities, designated respectively as Harbor Flats and Potomac Flats. By the first was meant that portion of the river immediately below the Long Bridge and between the two navigable channels. By the second was meant any locality below the city, sufficiently removed from the channel and otherwise suitable for dumping, which the bidder might be able to find.

The following bids were received and opened, September 11, 1880.

Abstract of proposals for dredging in Washington Channel, Harbors of Washington and Georgetown, D. C., opened September 11, 1880.

No.	Name and address.	For deposit on Potomac Flats, per cubic yard.	For deposit on harbor flats, per cubic yards.	Time of commencement.	Time of completion.	Number and kinds of machines.	Daily amount of work expected.
				1880.	1881.		*Cu.yds.*
1	National Dredging Company, 1420 New York avenue, Washington, D. C.	$0 14	$0 21	Oct. 15.	June 30.	The requisite machinery	....
2	Thos. P. Morgan, jr., Cumberland, Md.	22	26	....	....	Clam shell	800
3	Frank Pidgeon, jr., 116 Wall street, New York City.	17	28	Sept. 11.	June 30.	Two Osgood dredges..	700 or more.

The National Dredging Company were the lowest bidders for both localities of deposit, and it was held that inasmuch as the appropriation was for "continuing the improvements" provided for by the act of March 3, 1879, which directed that the amount therein appropriated "be so expended as to produce the greatest immediate benefit to navigation," that bid must be accepted which permitted the greatest amount of material to be taken from the channel.

The contract was accordingly awarded to the National Dredging Company at 14 cents per cubic yard, deposited on the Potomac Flats, and articles of agreement were entered into with them October 9, 1880, the work to begin on or before March 1, 1881, and to be completed on or before June 30, 1881.

Early in the spring the contractors brought their plant around and the channel was laid out for work, but their efforts to find a dumping ground were fruitless, all suitable localities being claimed by the owners of adjacent lands as valuable to them for fishing privileges, and the contractors threatened with injunctions and suits for damages in case they were used for dumping grounds.

The contractors, under date of March 26, 1881, communicated the obstacles in the way of a fulfillment of the contract, by the terms of which they were required to find dumping grounds, and while avowing their readiness to proceed in its execution if, by any means, the requisite dumping grounds could be secured to them by the government, asked that, in case such arrangements could not be made, their contract be annulled. There being no practicable way in which the dumping grounds could be secured (except at the risk of involving the government by claims for damages in invading private rights, or by an outlay for the purchase of these rights, which could not be recommended on the part of the government, nor reasonably demanded of the contractors), it was recommended, March 28, 1881, that the contract be annulled, and that the amount available therefor be added to the amount appropriated, March 3, 1881, and let under a new contract.

This accommodation was approved June 6, 1881, and the contract annulled by order of the Secretary of War.

Accordingly estimates were made, and specifications prepared for work with the combined funds of the two appropriations, from the former of which $10,000 had been reserved, and from the latter $15,000 set apart, for the removal of rocks in Georgetown Harbor.

Proposals were solicited by public advertisement dated June 9, 1881, to be opened July 9, 1881.

GEORGETOWN HARBOR AND CHANNEL.

No work was done during the year upon Georgetown Channel for the reason stated before, that a channel sufficient for the needs of commerce had been obtained by work under a previous appropriation.

Georgetown Harbor was again examined for rocks, several of which, not hitherto located, were found, located, and minutely surveyed by soundings from rafts anchored over them.

Estimates of the amount of excavation needful to secure safe passage to vessels over them were made, and specifications prepared.

Proposals for the work were solicited by advertisement dated June 9, 1881, the proposals to be opened July 9, 1881.

THE FLOOD OF FEBRUARY, 1881.

The year was marked by a flood unprecedented in the extent of its encroachment upon the city limits as well as in the amount of damage inflicted upon shipping and wharf property.

The winter had been unusually severe in the long continuance and intensity of its period of cold, during which 23.2 inches of snow had fallen and unusually thick ice had formed over the river. A rise of a few feet only in the river from rains and melted snow caused a breaking up of this ice, which gorged and so obstructed the water-way that, although the freshet above Georgetown did not attain the height of 1877 by 3 feet, it rose to a height of 12.25 feet above low-water at the Long Bridge, or 3.19 feet higher than the freshet of 1877.

The accompanying map exhibits the line of overflow, and the profile shows the water-surface of both floods.

The ice broke at Georgetown about 1 a. m. on Saturday, February 12, 1881, the stage of the river being 2 to 3 feet above high-tide, but rapidly rising as the ice passed down and added to the gorge below, until the highest water was reached at 7 p.m., being about .8 of a foot higher, than the flood of 1877.

At Georgetown comparatively little damage was done, owing chiefly to the precautions taken to secure shipping and movable property on the wharves. Along the Washington wharves the ice began to break about 2 a. m., the water being 4 to 5 feet above high-tide, and moved off rapidly with the current, the channel at times being nearly clear of ice.

That the gorge did not first form at the Long Bridge, so far, at least, as concerned the Washington Channel, is proved from the fact that between 3 and 4 o'clock a. m., on Saturday, February 12, a longboat and several scows were swept away from Seventeenth-street Wharf and carried through the Washington draw, and the longboat was found during Saturday lodged in the gorge below Arsenal Point, the scows having been carried still further down the river.

The *complete* gorge was formed below Arsenal Point, commencing about 7.30 a. m., and the successive additions of floating ice soon caused it to extend to the Long Bridge.

Whether a gorge was complete across Georgetown Channel at this point before the lower gorge extended to the bridge is not determined, but subsequently to it the gorge became complete the whole length of the bridge. It is believed, however, from the fact that large quantities of ice came across the flats above the Long Bridge and passed through the Washington Channel, that a gorge, independent of that below, was formed across Georgetown Channel at the Long Bridge, at or about the time of its formation below.

By 9 a. m. the entire water-way of the Long Bridge was choked. An occasional movement of short duration only served to jam the ice more closely and raise it higher, until the water passed over the causeway and 2.2 feet above it. The pressure upon the bridge became greater than it could withstand, and about 8.30 p. m. three spans of the north end gave way and were swung around upon the flats below. This movement, together with a break in the railroad embankment between the river and Fort Runyon (which is one-third of a mile from the Virginia end of the Long Bridge, and on the railroad to Alexandria), 1,006 feet in length, so far relieved the pressure that no further damage was done the bridge.

By Sunday morning the water, which had been 2½ feet higher on the Washington wharves than in the freshet of 1877, was off the wharves, but large piles of ice remained upon them, and many which escaped serious injury from lateral pressure while the ice was running, were crushed when the water, by its subsidence, withdrew its buoyant support.

As usual during freshets, though to an unprecedented extent, the low portion of the city along the Mall and extending across Pennsylvania avenue was flooded, and a large amount of damage was caused by the flooding of cellars and first floors.

The area of the flooded district was about 254 acres.

The time of highest water was about 7 p. m.

The following are the heights above low-water of the freshets of 1877 and 1881, at the several points named:

Localities.	1877.	1881.
Outlet lock above Georgetown	19.72	16.78
Aqueduct Bridge	15.96	14.29
Rock Creek	13.35	13.77
Easby's Point	11.99	13.54
Above Long Bridge	9.06	12.26
Below Long Bridge	....	11.20
Arsenal Point	8.44	7.01
Giesborough Point	7.66	4.98
Navy-yard	7.73	5.01

The map and profile hereinafter mentioned as accompanying this report, show the line of overflow of the two floods and profiles of water surfaces at highest water.

PROPOSED WORK FOR THE YEAR ENDING JUNE 30, 1882—WASHINGTON CHANNEL.

The channel along the Washington wharves (now 200 feet wide and 12 to 13 feet deep, except for a width of 75 feet next the wharves, where the depth is 15 feet) is to be deepened to 15 feet at low-water for such width as the funds will permit, and extending from the Long Bridge to deep water at Arsenal Point. The material is to be deposited on the flats next below the causeway of the Long Bridge.

GEORGETOWN HARBOR AND CHANNEL.

Nine rocks in Georgetown Harbor requiring an excavation of 1,664 cubic yards, are to be removed or so much thereof as the funds will permit. One very small rock lies about 400 feet below Aqueduct Bridge, and 350 feet off the wharf line. Five of the rocks are from 15 to 40 feet off the wharves at and below the Kennebeck Ice Company's wharf. The remaining four rocks are off the G-street Wharf, the greater portion being within 50 feet, though two of the smaller rocks are respectively 125 and 250 feet off the wharf.

Georgetown Channel shows some shoaling at the usual locality of bar formation, between Easby's Point and Long Bridge, and should it reach a degree to cause inconvenience to navigation, the $30,000 of the appropriation of 1879, reserved for that purpose, will be applied to redredging the channel.

The greatest draught of vessels clearing from Georgetown during the year was 18½ feet.

PERMANENT IMPROVEMENT.

I would respectfully refer to the remarks under this head in my last annual report on the harbors at Washington and Georgetown. (Report of Chief of Engineers, 1880, page 748.)

With regard to the improvement of that portion of the river immediately below the Long Bridge, the views of engineers and commercial men interested seem to be in accord.

The plan is to fill up the flats below the Long Bridge between the Virginia Channel and a line parallel with the line of wharves and 800 feet from them, to a level 1 foot above the highest known freshet. The plan might be economized by at first filling only to 1 or 2 feet above ordinary high-tide, and afterwards using the ground as a dump for excavations and waste earth from the city, by approaches from the Long Bridge.

For the improvement above the bridge, three plans have been proposed:

1. That of the commission of 1872, which provides for but one channel, following generally the present Virginia Channel, and for the reclamation of all the area between that channel and the present water front of the city.

This plan involves the removal of part of Alexander's Island at the south end of the bridge, and a rebuilding of the Long Bridge to conform to the plan. A modification of this plan provides for a channel as a winter harbor, 800 feet wide along the Washington front as far up as the Long Bridge.

2. A plan which provides for two channels, the existing Virginia Channel, and a channel next the present water front of the city, the intervening area to be filled up above high-water mark.

A modification of this plan provides for a wide channel only along the wharves below the Long Bridge, while it is to be continued at a much reduced width to a point near Easby's wharf, where it will join the main channel, and where it should be closed by guard-gates in time of freshet.

This is claimed by its advocates as necessary for flushing the lower channel, and also as a commercial facility in permitting the passage of vessels direct from the Washington wharves to Georgetown, and thus avoiding the expense and delay in towing around by Arsenal Point.

A single channel, as contemplated in the first plan, but differing from it in simply providing a sufficiently high and wide embankment around the area between the channel and present water front, and utilizing the space thus inclosed for ponds for the United States Fish Commission.

The embankment is to be provided with inlet and outlet gates to retain the water entering at high-tide and discharge it at low-tide into the Washington Channel.

To this simple statement of the plans which have been discussed, I would add that any further discussion of the subject should, in view of the survey ordered by Congress, and with the execution of which I am charged by you, be deferred until my report upon the results of that survey shall provide an opportunity to present the subject in connection with such information as the survey may add to what is already known of the natural and artificial peculiarities of the portion of the river composing or influencing this harbor.

A greater reason for deferring discussion exists in the fact that a sub-committee of the Senate Committee on Commerce was, at the last session, ordered to report to the committee on this subject, and it is understood their labors will soon be commenced.

Their report will, doubtless, be thorough and exhaustive, and, instead of forestalling their conclusions by a further presentation of the question at this juncture, it seems proper to endeavor, in the execution of the duty with which I am charged, to work in harmony with the committee, and to arrive at such conclusions, even though they be the result of a compromise of opinions, as will commend themselves as most likely to secure that unity of influence and purpose the want of which hitherto has clearly been the chief barrier to favorable consideration of the question by Congress.

CONTINUATION OF THE IMPROVEMENT UNDER PRESENT PROJECT.

The continuation of the improvement of the harbors at Washington and Georgetown, under the project so far approved or recognized, contemplates—

1. Keeping open and extending in width the Washington Channel as far as the Long Bridge, depositing the material taken therefrom on the adjacent flats.

For this work I respectfully recommend an appropriation of $100,000 for the year ending June 30, 1883. A smaller sum than this amount cannot be economically applied in works like this, requiring the provision by the contractor of a plant specially adapted to the work.

2. Redredging Georgetown Channel, at intervals of two to three

years, at the two localities where bars have been found to form to such an extent, in about that period, as to interfere with the navigation of the channel.

One of these points is between Easby's Point and the Long Bridge; the other opposite the United States arsenal grounds. For this work no additional funds are required at present.

3. Removing rocks in Georgetown Harbor and at the outlet lock and inclined plane of the Chesapeake and Ohio Canal above Georgetown.

For completing the removal of rocks in Georgetown Harbor and at the outlet lock, I respectfully recommend an appropriation of $50,000 for the year ending June 30, 1883.

This work also requires special appliances, and, to secure economical results, the whole amount asked for should be appropriated in one sum.

Appropriations have been made as follows:

June 11, 1870	$50,000
March 3, 1873	50,000
June 18, 1878	50,000
March 3, 1879	50,000
June 14, 1880	40,000
March 3, 1881	50,000

The work is in the collection district of Georgetown, which is the nearest port of entry.

The collections for the year ending June 30, 1881, were $18,104.23.

Fifth light-house district; nearest light-house, Jones's Point.

A map accompanies this report showing present condition of the improvement, and the lines of overflow of the floods of 1877 and 1881; also, a profile of water surfaces of these floods.

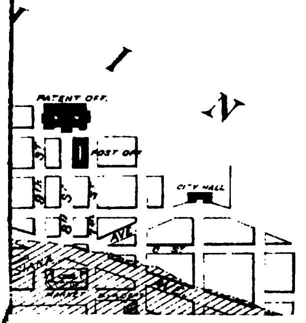
Money statement.

July 1, 1880, amount available	$75,227 92	
Amount appropriated by act approved March 3, 1881	50,000 00	
		$125,227 92
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,359 61	
July 1, 1881, outstanding liabilities	70 30	
		4,429 91
July 1, 1881, amount available		120,798 01
Amount (estimated) required for completion of existing project		240,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		150,000 00

STATISTICS OF TRADE.

The following items have been collected as comprising the principal articles of traffic during the year 1880, but are not to be understood as showing the total trade, which would no doubt be largely increased by the numerous smaller items which have not been reported.

Articles.		Quantity.	Value.
Coal	tons	802,190	$2,966,643 00
Stone, building and paving	do	28,066	151,640 00
Ice	do	90,000	360,000 00
Asphalt	do	2,167	25,089 00
Salt	do	3,000	30,000 00
Hay and straw	do	19,927	370,790 00
Grain	bushels	2,083,900	1,892,335 00
Flour	barrels	219,422	1,261,677 00
Cement	do	83,000	112,000 00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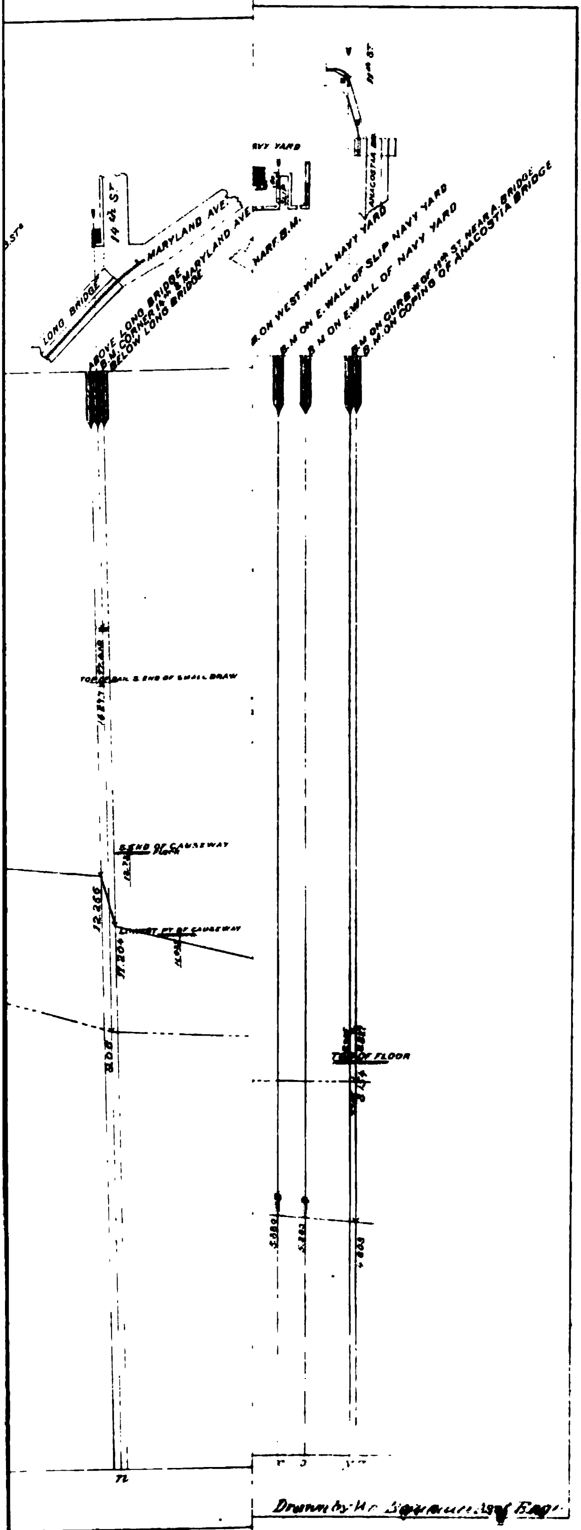
B. STS
14th ST.
LONG BRIDGE
MARYLAND AVE.
MARYLAND AVE.
NAVY YARD
WHARF B.M.
11th ST.
ANACOSTIA
ABOVE LONG BRIDGE
B.M. CORNER 14th & MARYLAND AVE.
BELOW LONG BRIDGE
B.M. ON WEST WALL NAVY YARD
B.M. ON E. WALL OF SLIP NAVY YARD
B.M. ON E. WALL OF NAVY YARD
B.M. ON CURB W. OF 11th ST. NEAR A. BRIDGE
B.M. ON COPING OF ANACOSTIA BRIDGE
TOP OF RAIL S. END OF SMALL DRAW
S. END OF CAUSEWAY
12.266
LOWEST PT. OF CAUSEWAY
11.204
TOP OF FLOOR
5.880
5.882
4.805
Drawn by W. Seymour Asst. Engr.

Articles.	Quantity.	Value.
Plaster of Paris ... barrels	8,000	$12,000 00
Lime ... do	23,000	19,700 00
Sand ... cubic yards	99,000	49,500 00
Fish and oysters	....	77,185 00
Hides (beef) ... number	22,500	185,000 00
Beef cattle ... do	25,199	1,007,334 00
Calves ... do	2,601	47,896 00
Sheep ... do	56,223	200,277 00
Hogs ... do	32,500	260,000 00
Lumber ... feet B. M.	32,700,000	586,600 00
Laths and pickets ... number	19,000,000	47,150 00
Shingles, cypress ... do	8,000,000	49,600 00
Cedar posts ... do	21,000	4,200 00
Wood ... cords	30,000	90,000 00
Potatoes ... barrels	20,000	35,000 00
Naphtha and crude oil ... do	5,700	24,250 00
Cast iron pipe ... tons	200	1,550 00
Total of above-named items		9,758,413 00
MISCELLANEOUS FREIGHT.		
By railroad ... tons	99,189	....
By New York steamers ... do	56,250	....
By Philadelphia steamers ... do	25,000	....
By Norfolk steamers ... do	40,000	....
By Baltimore steamers ... do	4,000	....
By river steamers ... do	31,000	....
	255,439	
MANUFACTURES.		
Flour ... barrels	176,000	1,114,000 00
Mill feed ... bushels	453,000	90,000 00
Corn meal ... do	350,000	210,000 00
Flour barrels, new ... number	75,000	27,000 00
Flour barrels, repaired ... do	150,000	30,000 00
Lime ... bushels	204,635	9,023 00
Limestone dust ... tons	800	4,800 00
Bricks ... number	74,500,000	484,250 00
Fertilizers ... tons	15,000	163,000 00
Chemicals	....	23,498 00
Products of coal tar	....	20,000 00
Galvanized cornice	....	25,000 00
Products of founderies and forges	....	443,760 00
Terra cotta manufactures	....	30,772 00
Cigars	....	30,500 00
Papers	....	70,400 00
Lager beer	....	29,443 00
	....	2,785,446 00

Internal-revenue collections	$123,360 46
Arrivals and departures of steamers	734 00
Arrivals and departures of sail-vessels	3,424 00
Arrivals and departure of canal-boats	5,934 00

A large number of small vessels trading on the river in fruits and vegetables are not included in the above.

Greatest draught of steamers	16 feet.
Greatest draught of sail-vessels	18.5 "

H 2.

IMPROVEMENT OF POTOMAC RIVER AT MOUNT VERNON, VIRGINIA.

HISTORY OF OPERATIONS.

Previous to the commencement of this improvement great difficulty had been experienced in navigating the wide flats between the main channel of the Potomac River and the wharf at Mount Vernon.

The ruling depth over the flats at low-water was but 4 feet, and the Mount Vernon steamer carrying passengers and mails was often unable to reach the wharf.

The Potomac River is subject to extremely low tides during the prevalence of northwest winds in the spring and fall, and at such times the difficulty was greatly increased.

The approved project for the improvement was the excavation of a channel 150 feet wide, and 6 to 7 feet deep at low-water, between the ship channel of the Potomac and the wharf at Mount Vernon, with a turning basin of adequate dimensions at the wharf.

An appropriation of $4,000 was made March 3, 1879.

A contract was entered into September 26, 1879, with G. H. Ferris, for executing such portion of the project as the funds would permit.

Work under this contract was begun October 11, 1879, and completed December 4, 1879, when a channel 75 feet wide and 6½ feet deep at low-water, had been excavated from the Potomac channel to the wharf, and also a circular turning basin at the wharf of the same depth.

WORK OF THE PAST FISCAL YEAR.

Under the appropriation of $3,000 by act of June 14, 1880, specifications were prepared and the work offered for contract by public advertisement dated July 21, 1880. Proposals were opened September 11, 1880.

Abstract of proposals for dredging in channel in Potomac River at Mount Vernon, opened September 11, 1881.

No.	Name and address.	Price per cubic yard.	Time of commencement.	Time of completion.	Number and kinds of machines used.	Daily amount of work expected.
						Cu. yds.
1	G. H. Ferris, Baltimore, Md.	$0 14	March 15, 1881.	July 1, 1881.	All machinery required.	....
2	Henry P. Gilbert, Georgetown, D. C.	17	Spring of 1881.	As early as practicable.	One Osgood dredge.	400
3	National Dredging Company, Washington, D. C.	12½	As early as practicable.	June 30, 1881.	Requisite machinery.	....
4	Henry Birch, Washington, D. C.	18	October 1, 1880.		One Osgood dredge.	400

The National Dredging Company being the lowest bidders the contract was awarded to them, and articles of agreement entered into under date of October 6, 1880, at the price of 12½ cents per cubic yard, the work to be completed on or before June 30, 1881.

Work was begun on the 29th of March, 1881, with one clamshell dredge, and completed on the 21st of April.

The various delays caused principally by high winds, amounted to four days, leaving seventeen days of actual work, during which 21,005.5 cubic yards were dredged, or an average of 1,238.5 per full working day.

The material to a depth of 7 or 8 feet was soft mud easily dredged, with an occasional log found which had lodged during some freshet.

But when the center of the old channel was dredged deeper (9 to 10 feet) a tenacious mud was found, mixed with partially decayed vegetation, which rendered the material difficult to clear from the scows in dumping.

The material was deposited on the flats three-fourths of a mile above the channel dredged, and to the right of the Potomac channel looking down stream.

The work of the year has resulted in widening and deepening the channel to the dimensions of 110 feet in width and 9 feet in depth at centre, at low-water, and enlarging the turning basin to a radius of 150 feet from the outer angle of the wharf. Both the width of channel and area of turning basin are, however, still insufficient to prevent the boat being borne against the sides of the channel in windy weather, or to preserve the required depth in such soft mud.

To increase the width of the channel to a degree that will insure permanency of depth, and to enlarge the basin to the dimensions desired, an appropriation of $5,500 is respectfully recommended.

So small a sum required to complete the improvement ought, for reasons of economy in its application, to be appropriated in one sum, to be expended in the fiscal year ending June 30, 1883.

The Regents of the Mount Vernon Association have expended large sums in improving the estate, restoring the mansion and furniture to the semblance of its early days, and added objects of curiosity and interest to this already favorite place of pilgrimage to the patriotic, and it seems a proper recognition of the efforts of the ladies who have thus preserved it that Congress should by the prompt completion of the channel, afford the needed facilities of access to so historical a spot as the home of Washington.

The following appropriations have been made:

March 3, 1879	$4,000
June 14, 1880	3,000
March 3, 1881	1,500

The work is in the collection district of Alexandria, which is the nearest port of entry. The collections for the fiscal year ending June 30, 1881, were $2,641.96.

Money statement.

July 1, 1880, amount available	$3,043 57	
Amount appropriated by act approved March 3, 1881	1,500 00	
		$4,543 57
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	3,036 75	
July 1, 1881, outstanding liabilities	6 30	
		3,043 05
July 1, 1881, amount available		1,500 52
Amount (estimated) requiredfor completion of existing project		5,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		5,500 00

H 3.

IMPROVEMENT OF NEABSCO CREEK, VIRGINIA.

In accordance with a provision in the river and harbor act, of June 14, 1880, a survey of Neabsco Creek was made in August, 1880, under your instructions of June 17, 1880.

My report, dated January 7, 1881, was printed in House Ex. Doc. No. 41, Forty-sixth Congress, third session, and from it I extract the following:

Neabsco Creek, or Neapseco, as it is spelled on the Coast Survey chart, is about 28 miles below Washington City, and is situated in Prince William County, Virginia, and in the collection district of Alexandria. It is a tributary of the Potomac River and enters it southwest of Occoquan Creek. It widens out at the mouth, extending over a flat 2,500 feet.

The shipments from the landings are now made in longboats, drawing from 3 to 4 feet of water, which take advantage of the tide to run over the flat at the mouth of the creek, and passing upward enter a narrow and tortuous channel, which extends through a marsh of rank vegetation for a distance of 6,470 feet to the head of navigation. The channel through the marsh averages about 40 feet wide at the surface, with a depth of 2.5 feet at the center. The vegetation on each side would greatly increase the cost of dredging a channel of a width greater than its present dimensions.

During the low-tides which prevail with winds from the northwest, boats are delayed for several days. The improvement of the creek would benefit about 50 square miles of land.

Four-fifths of this section is well timbered. The yearly exports are 4,000 cords of wood, 10,000 cross-ties, 75,000 hoop-poles, and 2,000,000 feet of lumber from Willis's saw-mill, besides staves and smaller articles. The fisheries of Col. J. W. Fairfax at Frestone Point rent for $1,300 per annum. The fisheries of Mr. J. Neglee on the left bank near the mouth of the stream are of no value at the present time. The soil is well adapted to grazing, and to the growth of grain and fruits, and attention is being given to bringing the land under a better system of cultivation. A good quality of slate is found about 2 miles from the head of tide, but is not quarried owing to the cost of transporting it to market. Iron was at one time smelted in the vicinity.

This section of country was early settled.

Ships were formerly built on the banks of the Neabsco, which were engaged in foreign commerce, and shipment of wheat and other produce was made. Now the Alexandria and Fredericksburg Railroad crosses the stream near its mouth, and has a good station on its right bank. The draw of the railroad bridge is at an angle with the present channel, and when opened gives two clear passage-ways for vessels, one 21 feet wide, the other 18 feet.

CHARACTER OF THE PROPOSED IMPROVEMENT.

The residents who are interested in the proposed improvement desire a channel for light-draught steamers from the 7-foot curve, in the Potomac River, to a point as near as may be practicable to the crossing of the Telegraph and Colchester roads. But in order to reach the cross-roads, it would be necessary to make a solid cut through a marsh for a distance of 2,000 feet. I have therefore limited the length of the estimated channel, by stopping at Atkinson's upper landing, a distance of 14,770 feet from the 7-foot curve in the river. Atkinson's lower landing is 11,650 feet from the same point, and both these landings are upon the north side of the creek. Willis's Landing, where the proposed channel also touches, is upon the south side, and is 7,510 feet from the 7-foot curve in the river.

The following estimate gives the cost of dredging a channel 7 feet deep at low-water, and 100 feet wide, 20 per cent. being added for the reflow of soft material from the sides of the cut:

I. Cost of a channel 7 feet by 100 feet from the 7-foot curve to Willis's Landing, distance 7,510 feet:

106,860 cubic yards, at 20 cents per yard	$21,360
Add 10 per cent. for contingencies	2,136
Total	23,496

II. Cost of a channel of 7 feet by 100 feet from the 7-foot curve to Atkinson's lower landing, including the landing at Willis's Wharf, distance 11,650 feet:

184,300 cubic yards, at 20 cents per yard	36,860
Add 10 per cent. for contingencies	3,686
Total	40,546

III. Cost of a channel 7 feet by 100 feet from the 7-foot curve to Atkinson's upper landing, including a channel to Atkinson's lower landing and Willis's Wharf, distance 14,770 feet:

254,200 cubic yards, at 20 cents per yard	50,840
Add 10 per cent. for contingencies	5,084
Total	55,924

A channel of smaller cross-section than that given above would, if permanent, answer for the present and prospective need of trade, but as it would rapidly deteriorate, the channel above estimated would be more economical and satisfactory.

A cut of the same cross-section as that given above as far as Willis's Wharf, and continued to Atkinson's upper landing, with the depth reduced to 6 feet and 40 feet wide, would cost, including contingencies, $37,000.

The first appropriation for work on this creek was made in the river and harbor act of March 3, 1881, the amount being $5,000.

Under this appropriation specifications were prepared and proposals solicited by public advertisement, dated June 9, 1881, the proposals to be opened July 9, 1881.

The draw of the railroad bridge being insufficient to admit a dredge, the superintendent of the road, at my request, promptly ordered it to be widened, and it is understood that the work has been done.

The improvement is in the collection district of Alexandria, which is the nearest port of entry. The collections for the year ending June 30, 1881, were $2,641.96. The nearest light-house is Fort Washington, in the fifth light-house district.

Money statement.

Amount appropriated by act approved March 3, 1881		$5,000 00
July 1, 1881, amount expended during fiscal, exclusive of outstanding liabilities July 1, 1880	$2 00	
July 1, 1881, outstanding liabilities	9 63	
		11 63
July 1, 1881, amount available		4,988 37
Amount (estimated) required for completion of existing project		51,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		20,000 00

H 4.

IMPROVEMENT OF BRETON BAY, LEONARDTOWN, MARYLAND.

HISTORY OF OPERATIONS.

The survey of Breton Bay was made in December, 1874, under the direction of Col. William P. Craighill, Corps of Engineers, and his report upon the same, together with estimates of the cost of the proposed improvement, are contained in the report of the Chief of Engineers for 1875, Part II, page 108.

The improvement was authorized by the river and harbor act approved June 18, 1878, in which $5,000 was appropriated for the commencement of the work.

The obstruction to navigation consisted in shoal water at the head of Breton Bay, constituting the harbor of Leonardtown, where there was but 5 feet of water, gradually deepening about 1 mile below Leonardtown to 9 feet. The material was soft mud.

The plan of operations approved by the Chief of Engineers was the excavation of a channel 150 feet wide and 9 feet deep at low-water through the shoal to the Leonardtown wharf.

Proposals for dredging the channel were invited by public advertisement June, 29, 1878, and opened July 22. The contract was awarded to G. H. Ferris, of Baltimore, at 12½ cents per cubic yard.

Work was commenced February 25, 1879, and closed March 21, 1879.

The funds were sufficient for the excavation of a 60-foot channel, through the shoalest water from the turn in the bay, to Leonardtown Wharf, and for dredging a part of the proposad basin for turning steamers.

Under the river and harbor act of March 3, 1879, appropriating $4,000 for continuing the improvement, a contract was entered into December 12; 1879, with Geo. C. Fobes & Co., for excavating material in continuation of the project.

Work under this contract was begun March 9, 1880, and completed March 20, 1880, the basin being enlarged to a width of 250 feet and a length of 400 feet, and the channel widened 30 feet for a distance of 2,400 feet from the wharf, giving a total width of 90 feet for that distance, and leaving 700 feet of the channel excavated in 1879, 40 feet wide.

WORK OF THE PAST FISCAL YEAR.

The river and harbor act of June 14, 1880, appropriated $3,000 for continuing the improvement.

The appropriations for Breton Bay and Nomini Creek being small in amount, and the localities comparatively near each other, proposals were invited for dredging at these two localities with a view of letting both works under one contract. The following bids were received and opened September 11, 1880.

Abstract of proposals for dredging at Breton Bay, Leonardtown, Md., opened September 11, 1880.

Number.	Name and address.	Price per cubic yard.	Time of commencement.	Time of completion.	Number and kinds of machines used.	Daily amount of work expected.
						Cu. yds.
1	National Dredging Company, 1420 New York Avenue, Washington, D. C.	$0 15	As early as practicable.	June 30, 1881	The requisite machinery.	
2	Henry P. Gilbert, Georgetown, D. C.	17	October 1, 1880.	....	One or more Osgood dredges.	400
3	G. H. Ferris, Baltimore, Md...	13½	March 1, 1880.	July 1, 1881.	....	
4	Daniel Constantine, do.........	20	January 1, 1881.		One Osgood dredge.	300-400

The contract was awarded to the National Dredging Company at 15 cents per cubic yard, the aggregate of their bids for the two works being the lowest. Articles of agreement were accordingly entered into with them October 6, 1880.

Work was begun on the 11th of April, 1881, with one clamshell dredge and was completed in 11 days, during which time the total delays amounted to about two days, leaving nine days as the actual working time; 17,976 cubic yards of material were taken out, or an average of 1,997 cubic yards per actual day of work.

The material was deposited in Echo Bend, about 1½ miles below the work, and on the left going out.

The channel was widened from 90 feet to 115 feet, for a distance of 2,700 feet, and the basin was increased in width 40 feet.

The amount required for the completion of this improvement is $15,000, and it is respectfully recommended that that amount be appropriated for the year ending June 30, 1883.

The amount originally estimated was $30,000.

Appropriations have been made as follows:

June 18, 1878	$5,000 00
March 3, 1879	4,000 00
June 14, 1880	3,000 00
March 3, 1881	3,000 00

The work is in the collection district of Annapolis, which is the nearest port of entry.

The collections for the year ending June 30, 1881, were $718.71.

The work is in the fifth light-house district, and the nearest light-house is Blackistone's Island light.

Money statement.

July 1, 1880, amount available	$3,116 40	
Amount appropriated by act approved March 3, 1881	3,000 00	
		$6,116 40
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		3,101 24
July 1, 1881, amount available		3,015 16
Amount (estimated) required for completion of existing project		15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		15,000 00

STATISTICS OF TRADE.

About 18 square miles of country are tributary to Leonardtown, containing a population of about 1,200.

Value of receipts during the year 1880	$121,650 00
Value of shipments during the year 1880	59,750 00

The excess of receipts over shipments is accounted for by the residence of non-producing visitors as summer boarders, and by the residence of professional men in Leonardtown, as the county seat.

There is invested in mills, factories, hotels, and business houses, a capital of $64,500 and the amount of business in 1880 was $128,700.

Three steamers arrive and depart, each twice per week, and other boats run in from time to time.

A large portion of the trade naturally tributary to this harbor has been drawn off to other wharves on the Potomac and Patuxent on account of insufficient channel, heretofore, to the Leonardtown Wharf.

H 5.

IMPROVEMENT OF NOMINI CREEK, VIRGINIA.

HISTORY OF OPERATIONS.

A survey of the creek was made in November, 1872, under the direction of Col. William P. Craighill, Corps of Engineers, whose report, with estimate of the cost of the work, will be found in the report of the Chief of Engineers for 1873, page 822.

Nomini Creek is an important tributary of the Potomac, which it enters about 82 miles below Washington.

It drains a large area of productive country, but at the time of the survey its navigation was obstructed by a bar of sand and oyster shells at its mouth over which but 3 feet could be carried at low-water.

The dangers and difficulties of passing the bar were still further increased by cross-tides and a rapid current, caused by the large tidal space in the creek to be filled and emptied at each tide.

After passing the bar a wide and navigable stream is found, in which 8½ feet can be carried for 2½ miles above the ferry.

The improvement proposed was the excavation of a channel 100 feet wide and 9 feet deep at low-water through the bar, and the estimated cost was $20,000.

The first appropriation made, March 3, 1873, was $10,000, and under it a channel 50 feet wide, and having a least depth of 7 feet at low-water, was dredged through the bar.

An additional appropriation of $6,000 was made June 23, 1874.

In July, 1874, the work was transferred from Colonel Craighill to myself.

Under this appropriation the channel dredged the previous year was widened and deepened.

An appropriation of $5,000 was made March 3, 1875. Under this appropriation the channel near White Point, and between Hickory and Ice-House Points, was further widened and deepened.

The average width was then 90 feet, except at White Point, where the width was increased to 200 feet to counteract the effect of cross-currents.

No further appropriation was made until March 3, 1879, when $2,500 was appropriated, with which sum the channel between White Point and Ice-House Point was widened about 25 feet, and a small bar, which had formed across the channel near the latter point, was removed. The increase in the trade and the great public benefit derived from the work up to this time calling for a greater width of channel, both to accommodate the existing wants of commerce and to insure permanency of the improvement already affected, a modification of the original project was proposed in 1879, providing for a width of 150 feet, and an estimate of $15,000 submitted as necessary to carry out the modified project.

WORK OF THE PAST FISCAL YEAR.

The river and harbor act of June 14, 1880, appropriated $5,000 for continuing operations.

The appropriations for Nomini Creek and Breton Bay being small, and the localities comparatively near each other, proposals were invited for dredging at these two localities, with a view of letting both works under one contract.

The following bids were received and opened September 11, 1880.

Abstract of proposals for dredging at Nomini Creek, Virginia, opened September 11, 1880.

No.	Name and address.	Price per cubic yard.	Time of commencement.	Time of completion.	Number and kinds of machines used.	Daily amount of work expected.
						Cu. yds.
1	National Dredging Company, Washington, D. C.	$0 20	As early as practicable.	June 30, 1881	Requisite machinery.	....
2	Henry P. Gilbert, Georgetown, D. C.	25	Oct. 1, 1880	....	One or more Osgood dredges.	300–400
3	G. H. Ferris, Baltimore, Md.	26	Mar. 1, 1881	July 1, 1881.	....	....
4	Daniel Constantine, Baltimore, Md.	32	Jan. 1, 1881	....	One Osgood dredge.	300–400

The contract was awarded to the National Dredging Company, at 20 cents per cubic yard, the aggregate of their bids for the two works of Nomini and Breton Bay being the lowest.

Articles of agreement were accordingly entered into with them October 6, 1880.

The work was begun on the 28th of April, 1881, with one clamshell dredge, which was not well adapted to the hard sand to be taken out. The limit of work which the funds allowed was reached June 17, when 21,271.5 cubic yards had been taken out.

During this period of fifty-four days, work was done on thirty-four days, averaging 625.6 cubic yards per day.

The material dredged was principally sand, some of it very hard, and was deposited in the bay, outside the point.

A channel 100 feet wide and 9½ to 10 feet deep was dredged from deep water in the bay to White Point.

The channel should be widened to 150 feet and continued with the same width and depth from this point to deep water in the creek above.

A revision, based upon surveys made since my last annual report, of the estimate heretofore given shows work to be done as follows:

56,000 cubic yards dredged, at 30 cents	$16,800 00
Contingencies, 15 per cent	2,520 00
Total	19,320 00

This amount includes $1,500 for a training-channel to divert the cross-current at White Point which now strikes the channel at right angles, and causes it to enter the channel as nearly as may be in the direction of its axis.

A short dam will also be needed to aid this diversion.

250 linear feet, at $4 per linear foot	$1,000 00
Contingencies, 15 per cent	150 00
	1,150 00
Total estimate	20,470 00

I respectfully recommend that $10,000 be appropriated for the year ending June 30, 1883.

Appropriations have been made as follows:

March 3, 1873	$10,000 00
June 23, 1874	6,000 00
March 3, 1875	5,000 00
March 3, 1879	2,500 00
June 14, 1880	5,000 00
March 3, 1881	2,000 00

The work is in the collection district of Tappahannock, which is the nearest port of entry.

The collections for the year ending June 30, 1880, were $1,177.54.

Money statement.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	2,000 00	
		$7,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,985 91	
July 1, 1881, outstanding liabilities	9 63	
		4.995 54
July 1, 1881, amount available		2,004 46
Amount (estimated) required for completion of existing project		20,470 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		10,000 00

STATISTICS OF TRADE.

No statistics of the present year have been collected, but the total value of shipments for the year 1879, which was $166,782.00, will probably represent the average yearly shipments.

SURVEY OF NOMINI RIVER, FROM THE FERRY ACROSS THE SAME TO THE HEAD OF TIDE-WATER.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., January 7, 1881.

GENERAL: I have the honor to submit the following report of a survey of Nomini River, from the Ferry to the head of tide-water, made in September, 1880, in accordance with a provision of the act of appropriation for rivers and harbors approved June 14, 1880, and assigned to me by your letter of June 17.

The survey extended from Holly Wharf, 1,000 feet below the Ferry, to Beale's Mill.

Nomini River unites at its mouth with Currioman Bay, and flows into the Potomac about 82 miles below Washington City.

It is situated in Westmoreland County, Virginia, and in the collection district of Tappahannock. The lower portion of the river has been improved by dredging a channel from the can-buoy in Currioman Bay to Hickory Point, a distance of 4,400 feet. Sixteen hundred feet of this distance is outside of White Point, at the mouth of Nomini River. This work was begun under an appropriation approved March 3, 1873, and has been continued by successive appropriations up to the present date. A marked improvement has been effected in the trade of this section of country by this work. The channel, which formerly had a ruling depth of 3 feet, has now a depth of from 9 to 10 feet. Four steamers, 3 from Washington and 1 from Baltimore, now ply to Nomini River. The larger part of the freight is shipped from Nomini Wharf, and lesser quantities from Mount Holly Wharf, 1,000 feet below, and Peach Point Wharf, 1,070 feet above. Two of the smaller steamers land and receive freight at Prospect Wharf (1½ miles above Nomini Wharf), to which point the channel is from 6 to 7 feet deep and from 100 to 500 feet wide, with the exception of one bar, where 2,000 cubic yards should be dredged in order to make the depth correspond with the rest of the channel. The improvement now desired by the residents is to make a channel from Prospect Wharf to Davis's White Point, a distance of 8,830 feet, with a depth of 7 feet at low-water, and a width of 100 feet.

Large vessels once came to Davis's White Point, but the placing of fishing weirs in the river, and the deposition of sediment by the floods, have caused a shoaling of the channel. About 25 square miles will be benefited by this improvement. From Davis's White Point to a bridge on the Warsaw road the distance is 3,400 feet, following a narrow channel through a marsh. A cut through this marsh is also desired, and an estimate for a channel 40 feet wide and 5 feet deep is given below, but the cost seems large in proportion to the interest to be benefited. The sum would be better expended in deepening and widening the channel from the can-buoy in Currioman Bay to White's Point, at the mouth of the river.

The proposed work above Davis's White Point might be left until the trade of the country was more fully developed, or at least until the channel was improved up to that point. Davis's White Point is a public landing easily accessible to the 25 square miles of country above mentioned, which is not the case with the other landings.

ESTIMATES.

The following estimates give the probable cost of dredging a channe 100 feet wide and 7 feet deep from Prospect Wharf to Davis's White Point, distance 8,830 feet; and from Davis's White Point to the bridge on the Warsaw road, width 40 feet, depth 5 feet, distance 3,400 feet; and also the cost of dredging through the bar below Prospect Wharf.

From Prospect Wharf to Davis's White Point, 8,830 feet by 100 feet by 7 feet:

159,900 cubic yards, at 25 cents	$39,975
2,000 cubic yards (bar below Prospect Wharf), 25 cents per yard	500
	40,475
Add 10 per cent. for contingencies	4,048
Total	44,523

From Davis's White Point to bridge on branch of Warsaw road 3,400 feet by 5 feet by 40 feet:

20,400 cubic yards, at 30 cents	$6,120
Add 10 per cent. for contingencies	612
Total	6,732
Total of both estimates	51,255

A gauge was left at Nomini Wharf having 3 feet, corresponding to mean low-water, as observed during the period occupied in making the survey. The plane of mean low-water was established at $\frac{5}{10}$ higher than that at Currioman. Both should be corrected by a longer course of observations.

* * * * * * *

Respectfully, your obedient servant,

S. T. ABERT,
United States Civil Engineer.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

H 6.

IMPROVEMENT OF HARBOR AT ENTRANCE TO SAINT JEROME'S CREEK, MARYLAND.

To comply with a resolution of the Senate of December 13, 1880, Lieutenant-Colonel Craighill, Corps of Engineers, was instructed to make an estimate of the cost of deepening the entrance to Saint Jerome's Creek, in Maryland, so as to make it an available harbor. This was transmitted to Congress in a report dated December 16, 1880, and will be found in Appendix G 28 (*ante*) of this report.

Upon this report was based the appropriation of $6,500 in the river and harbor act of March 3, 1881, for "improving the harbor at the entrance of Saint Jerome's Creek, Maryland."

Under instructions from the Chief of Engineers, dated March 26, 1881, specifications were prepared and immediately submitted to five selected contractors and proposals invited from these for executing the work without delay.

The following is an abstract of the proposals received, only three of the contractors bidding:

Abstract of proposals for dredging in harbor at entrance of Saint Jerome's Creek, Maryland opened April 12, 1881.

No.	Name and address.	Price per cubic yard.		Total amount.	Time of commencement.	Number and kinds of machines used.	Daily amount of work expected.
		Outer channel.	Inner channel.				
							Cu. yds.
1	Daniel Constantine, Baltimore, Md.	$0 29	$0 25½	$7,711 00	June 11, 1881..	1 dipper dredge.	[illegible]
2	Henry P. Gilbert, Georgetown, D. C.	40	15	7,610 00	April 20, 1881..	....do	200–[illegible]
3	Thomas P. Morgan, jr., Cumberland, Md.	35	15	6,940 00	10 days after signing contract.	1 dipper dredge and one clam-shell dredge.	

The work was awarded to Mr. Thomas P. Morgan, jr., the lowest bidder, and articles of agreement entered into with him under date of April 19, 1881.

The contractor having announced his readiness to proceed with the work, an assistant was sent down to lay off the channels in accordance with the sketch furnished by Mr. Hutton, upon which the channel lines were projected.

Mr. Hutton's examination was a mere reconnaissance, and was only claimed to be approximate. Upon a re-examination, the bar was found to be larger than represented by him, the actual amount of excavation required being found to be 34,000 cubic yards.

The propriety of modifying somewhat the location of the channels was indicated by further soundings, which were made with a view of determining its most favorable location, and the channels were laid out in accordance with the conditions then found to exist.

* * * * * * *

The channels laid out were:

1. A channel (designated as "the outer channel") through the bar at the mouth proper of the estuary, and which was designed to be 100 feet wide, and 9 feet deep at low-water.

2. A channel obliquely across the south prong of the creek, designated "the inner channel," and designed to be 30 feet wide, and 6 feet deep at low-water, the material from which was to be thrown up on the up-stream side so as to form a dike as far as the long point of land dividing the south prong from the main creek, and thus make a pond for the purposes of the Fish Commission. It was understood that this channel was to be continued by the Fish Commission through the low neck of land, and intercept the south prong at the first bend above its mouth.

The following are the estimates of excavation required for these channels:

	Cu. yds.
For the outer channel, 100 feet wide and 9 feet deep at low-water............	34,000
For the inner channel, 40 feet wide and 6 feet deep at low-water..............	14,200

The annual evaporation is greater than the rainfall, and the force which must keep the new cut open is limited by the small tidal capacity of the creek.

The counter effects of the storms from the east, southeast, and south will have the effect of closing the new channel.

The work of the contractor was delayed until May 16, in the effort to get fresh water for his boilers. This was finally accomplished by sinking wells near the locality.

The dipper dredge began work May 16, at the outer end of the inner channel, and for want of sufficient water to float the scows cast the material over, the intention being to take it up again by making a second cut, in case it was found to be injurious in that position or inclined to return to the cut. The material was found to be very hard clay with some shells. Two thousand one hundred and fifty cubic yards were dredged from this part of the channel, when the dredge was moved to the outer channel, on the 1st of June.

The grapple dredge began work May 20, in the inner portion of the inner channel, throwing the material up into a dike. The material was found to be very soft mud, and ran back into the cut and spread over the ground back of the dike to such an extent that it was found impossible to work to the specifications, and this portion of the work was discontinued on the 17th of June, in order to spend the remainder of the funds on the outer channel.

Ninety thousand and ninety-two cubic yards from the inner channel were put upon the dike, two-thirds of which had been completed as nearly in accordance with the specifications as was possible; the remaining one-third barely showing at high-water, owing to the spreading of the soft material.

The dipper dredge began work on the outer channel June 1, and the grapple dredge June 22.

The material was found to be exceedingly fine sand, closely packed and very hard to dig.

At the close of the fiscal year the work was in progress, with not sufficient funds remaining to complete the first cut of outer channel.

For the completion of this work $14,000 will be required, and I respectfully recommend an appropriation of that amount for the fiscal year ending June 30, 1883.

* * * * * * *

The work is in the collection district of Annapolis, which is the nearest port of entry. The collections for the year ending June 30, 1881, were $718.71.

Nearest light-house, Point Lookout, in the fifth light-house district.

No statistics of trade have been obtained.

Money statement.

Amount appropriated by act approved March 3, 1881	$6,500 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,921 48
July 1, 1881, amount available	1,578 52
Amount (estimated) required for completion of existing project	15,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	15,000 00

H 7.

IMPROVEMENT OF RAPPAHANNOCK RIVER, VIRGINIA.

The Rappahannock River, from Fredericksburg, the head of navigation, to Chesapeake Bay, is 104 miles long.

The survey from which the present operations for its improvement date was made in November, 1870, under the direction of Col. William P. Craighill, Corps of Engineers, and his report will be found in the Report of the Chief of Engineers for 1874, Part II, page 31.

ACCOUNT OF OBSTRUCTIONS.

The following table shows the localities which the Coast Survey maps indicated as requiring attention, and which were nearly all examined under the direction of Colonel Craighill.

They were re-examined under my direction in June, 1881, as far down as Farleyvale.

The table exhibits the depths found at the three periods of examination.

Table of localities on Rappahannock River, Virginia, from Fredericksburg to Farleyvale, inclusive, requiring improvement, with comparisons of the results of examinations in 1856, 1870, and 1881, and present estimate of cost of their improvement.

No.	Name of locality.	Distance from railroad bridge at Fredericksburg.	Coast Survey of 1856, low-water depth.	Colonel Craighill's survey of 1870.		Examination of 1881.	
				Low-water depth.	Length of bar.	Low-water depth.	Length of bar.
		Miles.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
1	Fredericksburg Bar	......	5.5	5.0	5,400	7.6	5,400
2	Pollock's Bar	1⅛	7.5	....	....	8.0	600
3	Bernard's Bar	2¼	10.5	....	....	8.4	700
4	Pratt's Bar	3¾	6.5	....	.....	8.0	1,000
5	Spottswood Bar	4½	6	7.0	5,400	7.8	4,200
6	Castle's Ferry Bar	8¼	5	7.0	2,100	7.9	1,800
7	Spring Hill Bar	10¼	8	10.0	....	10.5	....
8	Moss Neck Bar	11⅛	7	....	....	9.3	600
9	Farleyvale Bar	12¾	8	8.5	1,050	8.5	600

No.	Name of locality.	Distance from railroad bridge at Fredericksburg.	Estimates for improving channel 100 feet wide and 11 feet deep at low-water.				
			Cubic yards excavation.	Cost at 25 cents per cubic yard.	Linear feet of dike.	Cost at $4 per linear foot.	Total cost, including 15 per cent. for contingencies.
		Miles.					
1	Fredericksburg Bar	....	65,000	$16,250	350 *200	$1,400 3,000	.... $23,747 50
2	Pollock's Bar	1⅛	4,000	1,000	280	1,120	2,438 00
3	Bernard's Bar	2¼	4,700	1,175	410	1,640	3,237 25
4	Pratt's Bar	3¾	8,000	2,000	450	1,800	4,370 00
5	Spottswood Bar	4½	(†)	(†)	(‡)	(‡)	
6	Castle's Ferry Bar	8¼	13,336	3,334	1,100	4,400	8,894 10
7	Spring Hill Bar	10¼	(§)	(§)	(§)	(§)	
8	Moss Neck Bar	11⅛	2,668	667	450	1,800	2,838 55
9	Farleyvale Bar	12¾	4,000	1,000	450	1,800	3,220 00
	Total	....	....	....	....	....	48,745 40

* Crib dike, at $15 per linear foot.

† Dredging in progress.

‡ Dikes constructed.

§ No work required.

HISTORY OF THE IMPROVEMENT.

The several appropriations for improvement and the work done under them (full details of which will be found in the annual reports for the years mentioned) are here summarized, as follows:

March 3, 1871, $15,000. Under this appropriation channels 70 feet wide and 8 feet deep at low-water were dredged, by contract, through Spottswood and Fredericksburg bars, and completed September, 1872. Wrecks were removed by contract as follows: One at Fredericksburg, one at Spottswood bar, one at Piscataway Creek, one at Urbana, one at Laurie's Point, and two at Mill Creek.

June 10, 1872, $15,000. The channels at Fredericksburg and Spottswood bars were widened to 120 feet by contract, and the dredging completed in April, 1873. A dike 1,600 feet long was built along the left bank of the river opposite Fredericksburg, to confine the dredged material which was placed behind it, and to contract the water-way of the stream over the bar. A dike was also constructed along the left bank, below the steamboat wharf, to rectify the wharf line, and filled with dredged material.

March 3, 1873, $15,000. A freshet of unusual duration and height occured in May, 1873, which caused some filling in the Fredericksburg channel. It was therefore redredged by contract, the material being deposited behind the dikes and in the river below the bar. This work was concluded in November, 1873. The dike on the left bank was extended and connected with the shore.

Several logs and snags were removed below Spottswood Bar.

The work was transferred to my charge by Colonel Craighill in July, 1874. In his report of August 11, 1874, Colonel Craighill says:

> The appropriations by Congress since the estimate of 1871 (of $85,000 for 10-feet water) have been the following: $15,000 March 3, 1871; $15,000 June 10, 1872; $15,000 March 3, 1873; $7,000 June 23, 1874; total, $52,000. To complete the estimate, $33,000 are required, which would have done the work had the whole sum been at once appropriated and operations not interrupted.

June 23, 1874, $7,000. The available balance July, 1874, including this appropriation, was nearly $13,000. A dike was built by contract on the left bank of the river, between the railroad bridge and the ferry, and completed March 8, 1875. The channel was dredged along the wharf front, where it was found to have filled in. The sand was placed behind this dike (No. 2) and the channel completed 50 feet wide and 9 feet deep at low-water July 28, 1875.

March 3, 1875, $5,000. Applied to redredging the channel between Deep Run and the lower wharves as far as the funds permitted, the width being 50 feet and the depth 9 feet. The material was deposited behind the dike (No. 1) and the work concluded May 8, 1876.

August 14, 1876, $10,000. This appropriation was made available January 22, 1877. The dike built in 1872 on the right bank, below the steamboat wharf, had been injured by ice and was in danger of giving way and precipitating the sand behind into the channel. A new dike (No. 3) was therefore built outside of it, and so as to improve the line of the wharf front. This was done by contract, and completed June 12, 1877. The channel was also dredged between the steamboat wharf and Deep Run 50 feet wide and 9 feet deep, the contract being concluded July 26, 1877. Full details of the operations, briefly summarized, will be found in the several annual reports of the years mentioned.

June 18, 1878, $13,500. This appropriation was applied to building dikes and dredging at Fredericksburg Bar. Two dikes were built (No.

4) between the lower end of the city wharves and Hazel Run and (No. 5) on the left bank of the river (below dike No. 1). The work was done by contract, commenced September 7, 1878, and completed September 20, 1879. The dredging included the excavation of a channel along dike No. 4, the removal of the bar at the steamboat wharf, and the basin at this point for turning steamers. The work was done by contract, having been commenced November 25, 1878, and completed April 9, 1879. The sand dredged from the river was placed behind dikes Nos. 1, 3, and 4.

March 3, 1879, $10,000. This appropriation was made available June 5, 1879.

Dike No. 6, at Fredericksburg Bar, 605.5 feet long, was built by contract, for the protection of the bank below Hazel Run, and a crib dike, 80 feet long, was built by hired labor and the purchase of materials. This dike is nearly opposite the steamboat wharf, and was designed to reduce the water-way and preserve the depth which had been obtained by dredging.

At Spottswood 15 spur-dikes were built, of aggregate length of 2,046.6 feet. The entire reach in which Spottswood Bar occurs was examined, and 50 snags, 6 drift-logs, and one small wreck were removed.

WORK OF THE PAST FISCAL YEAR.

At the commencement of the year work on the spur-dikes at Spottswood Bar (mentioned above, under the appropriation of 1879) was in progress, under the contract with Mr. Alfred Kishpaugh, dated December 31, 1879. The entire length, as stated above, was 2,046.6 feet, but under the provision of section 14 of the specifications forming part of the contract, 515.3 linear feet were estimated as shore connection, and paid for at an average price of nearly $1.94 per linear foot; 1,531.3 linear feet being paid for at the contract price for full dike, $3.55 per linear foot.

The entire work under this contract was completed December 23, 1880, thus carrying over to the present year work which should have been completed during the previous year, and thereby entailing upon the government the expense of inspector's salary and other contingencies which might have been avoided by promptness on the part of the contractor in supplying material, and by energy in pushing the construction of the dikes.

There seems to be no cure for dilatory contractors but to insist upon the strict enforcement of the penalty of their bond which attaches to failure to perform the contract within a given time unless prevented by causes specially named. To contractors of this class in future notice of such strict construction of contract will be served at the commencement of operations.

In addition to the work by contract above described, cushions of brush were staked down to the banks at and immediately below the shore connection of all dikes which had not sufficient durable natural connections to withstand the erosion from freshets above the height of the dikes. This work was done by hired labor, and was deemed a necessary precaution until the material from the dredged channel could be deposited between the dikes.

The river and harbor act of June 14, 1880, appropriated $25,000 for continuing the improvement. The work projected under this appropriation was as follows:

1st. *At Fredericksburg*, the construction of eight spur-dikes to further contract the channel, aided by two deflecting dikes, one of piles in shoal water, the other in deep water, of crib-work filled with stone; a dike for protecting the shore between Hazel Run and Deep Run, and preserving the contraction of water-way; and a retaining-dike at the ferry landing.

2d. *At Spottswood Bar*, the construction of four additional spur-dikes to complete the original project for spur-dikes at that locality, and the excavation of a channel 100 feet wide and 11 feet deep at low-water, the material to be deposited between the spur-dikes (then in course of construction, but now completed).

Separate specifications were prepared for the two classes of work, dredging and dike construction, and proposals invited in the usual way.

The following are abstracts of the bids received and opened November 27, 1880.

Abstract of proposals for dredging at Spottswood Bar, Rappahannock River, Virginia, opened November 27, 1880.

No.	Name.	Address.	Price per cubic yard.	Time of commencement.	Time of completion.	Number and kind of machines used.
1	Daniel Constantine	Baltimore, Md	$0 27	December 10, 1880.	June 30, 1881.	One or more Osgood dredges.
2	Henry Birch	Washington, D. C.	19¾	As early as practicable.	June 30, 1881.	Do.
3	G. H. Ferris	Baltimore, Md	27¼	December 10, 1880.	June 30, 1881.	

Abstract of proposals for constructing dikes in Rappahannock River, Virginia, opened November 27, 1880.

No.	Name and address.	Price per linear foot for constructing dikes.				Total amount.	Time of commencement.	Time of completion.	Remarks.
		First class.	Second class.	Third class.	Fourth class.				
							1881.	1881.	
1	Wm. H. Wood, New York City. .	$3 65	$3 95	$3 90	$19 50	$13, 861 50	Jan. 4	June 30	
2	Frank Pidgeon, jr., Philadelphia, Pa.	3 80	4 10	4 25	15 00	13, 899 75	Jan. 4	June 30	Informal; no bond.
3	G. H. Ferris, Baltimore, Md.	3 49	3 49	3 49	18 00	12, 531 75	Jan. 4	June 30	
4	Alfred Kishpaugh, Fredericksburg, Va.	3 25	2 95	3 45	13 00	10, 666 75	Jan. 4	June 30	

The construction of dikes was awarded to Mr. Alfred Kishpaugh, of Fredericksburg, and articles of agreement were entered into December 6, 1880. The time of commencement was fixed at January 4, 1881, the work to be completed on or before June 30, 1881.

The dredging was awarded to Mr. Henry Birch, of Washington, and the contract was dated December 10, 1880. The 10th of December was the time fixed for the commencement of the work, which was to be completed on or before June 30, 1881.

The construction of the crib dike, an extension of that built in 1879, was begun February 7, 1881, and completed March 7, 1881. Its length is 100 feet, and the price $13 per linear foot.

Dikes A, B, C, D, E, and F had been constructed by the 4th of May, 1881, when the contractor was required to transfer the work to Spottswood Bar, so as to complete the dikes there, in readiness for the deposition of material between them by the contractor for dredging. These dikes were completed June 27, 1881, and the contractor resumed work at Fredericksburg. During the year there were constructed at Spottswood Bar 2,429.6 linear feet of spur-dike; and at Fredericksburg 100 feet of crib-dike, 555 linear feet of spur-dike, and 91 linear feet of dike for protection of shore below Hazel Run.

The contractor for dredging at Spottswood Bar was unable, on account of the severity of the winter, to move his machinery to the work, and did not begin operations until April 12, 1881. Soon after the beginning of this work, an examination of the projected channel showed that the freshet of February had taken away about 12,000 cubic yards of the amount estimated, and by your approval the contract was modified so as to permit the execution of this amount of work at Fredericksburg, off the principal wharves, where the depth had decreased to such an extent as to seriously inconvenience the approach and maneuver of vessels. To this work the contractor was directed to transfer his machinery, and it was begun May 12, 1881, and finished June 25, 1881; when the machinery was ordered back to Spottswood Bar, where at the close of the fiscal year the work was in progress, and at a rate much more satisfactory than at the beginning of his operations, when an insufficiency of scows and of appliances and labor for promptly moving them and discharging their contents very much retarded the work and has caused the time of completion to run over the fiscal year.

At the close of the year 20,572 cubic yards had been removed at Spottswood and Fredericksburg bars, under this contract, at 19¾ cents per cubic yard.

In addition to work under these contracts those portions of old dikes at Fredericksburg which were injured by ice in February have been repaired, and 800 willow bushes have been set out upon the filling behind them.

The ends of spur-dikes, both at Fredericksburg and Spottswood, have also been protected from the action of the current by deposits of stone upon brush mattresses. This last-named work was done by a minor contract with J. W. Mills for $1 per cubic yard of stone deposited, the price including cost of mattresses used.

The shore connections of such dikes at Spottswood Bar as seemed to need fortifying have been further secured by cushions of brush staked down to the banks. This work was done by hired labor.

The river and harbor act of March 3, 1881, appropriated $15,000 for continuing the improvement. It is thought best to defer its application until the behavior of the channel at Fredericksburg, under the influence of the dikes recently built and in progress, shall have demonstrated how far the expected results give promise of realization. It is expected, however, that six more short spur-dikes and two short crib-dikes will be needed to secure uniformity of construction throughout the entire bar, and that the fixation of the channel and its proper direction and uniformity of dimensions will be most satisfactorily secured by dredging, after which it is believed the dikes will maintain it in that condition. It may therefore be several months before specifications are submitted forwork under the last appropriation.

CONTINUATION OF THE IMPROVEMENT.

There will be required to secure a channel 100 feet wide and 10 to 11 feet deep at low-water, work at the localities named as follows:

FREDERICKSBURG BAR.

65,000 cubic yards dredging, at 25 cents	$16,250 00
350 linear feet spur dike, at $4	1,400 00
200 linear feet crib-dike, at $15	3,000 00
	20,650 00
15 per cent. for contingencies	3 097 50
	23,747 50

POLLOCK'S BAR.

4,000 cubic yards dredging, at 25 cents	$1,000 00
280 linear feet spur-dike, at $4	1,120 00
	2,120 00
15 per cent. for contingencies	318 00
	2,438 00

BERNARD'S BAR.

4,700 cubic yards dredging, at 25 cents	$1,175 00
410 linear feet spur-dike, at $4	1,640 00
	2,815 00
15 per cent. for contingencies	422 25
	3,237 25

PRATT'S BAR.

8,000 cubic yards dredging, at 25 cents	$2,000 00
450 linear feet spur-dike, at $4	1,800 00
	3,800 00
15 per cent. for contingencies	570 00
	4,370 00

CASTLE'S FERRY BAR.

13,336 cubic yards dredging, at 25 cents	$3,334 00
1,100 linear feet spur-dike, at $4	4,400 00
	7,734 00
15 per cent. for contingencies	1,160 10
	8,894 10

MOSS NECK BAR.

2,668 cubic yards dredging, at 25 cents	$667 00
450 linear feet dike, at $4	1,800 00
	2,467 00
15 per cent. for contingencies	371 55
	2,838 55

FARLEY VALE BAR.

4,000 cubic yards dredging, at 25 cents	$1,000 00
450 linear feet spur-dike, at $4	1,800 00
	2,800 00
15 per cent. for contingencies	420 00
	3,220 00
Total	48,745 40
Deduct appropriation of March 3, 1881	15,000 00
	33,745 40

As this sum will complete the improvement as far down as Farleyvale, including that bar, I respectfully recommend that $34,000 (in round numbers) be appropriated for the year ending June 30, 1883.

The following appropriations have been made:

March 3, 1871	$15,000
June 10, 1872	15,000
March 3, 1873	15,000
June 23, 1874	7,000
March 3, 1875	5,000
August 14, 1876	10,000
June 18, 1878	13,500
March 3, 1879	10,000
June 14, 1880	25,000
March 3, 1881	15,000

The work is in the collection district of Tppannock, which is the nearest port of entry. The collections for the year ending June 30, 1881, were $1,177.54. Fifth light-house district; nearest light-house, Bowler's Rock.

Accompanying this report are maps of Fredericksburg Bar and Spottswood Bar, showing their condition at the close of the fiscal year.

The trade of Fredericksburg for 1880 shows, omitting details of items, a total value of $4,000,000, or an increase of $396,000 over the previous year.

Money statement.

July 1, 1880, amount available	$31,835 13	
Amount appropriated by act approved March 3, 1881	15,000 00	
		$46,835 13
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	17,324 02	
July 1, 1881, outstanding liabilities	862 51	
		18,186 53
July 1, 1881, amount available		28,648 60
Amount (estimated) required for completion of existing project		222,345 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		34,000 00

H 8.

IMPROVEMENT OF TOTUSKI RIVER, VIRGINIA.

A survey and examination of Totuski River was ordered in the river and harbor act approved June 23, 1874, and this duty being assigned to me by the Chief of Engineers, July 9, 1874, a report and estimate were submitted March 3, 1875, based upon a personal reconnaissance. I quote from my report:

> Totuski River rises on the border of Northumberland County, Virginia, flows southwest through Richmond County, and empties into the Rappahannock River 35 miles from its mouth and 7 miles below the town of Tappahannock. It is 20 miles long, and has a width varying from 200 to 500 feet. About 5 miles from its mouth it is crossed by a bridge without a draw, over which passes the county road. The examination was, therefore, limited to the portion of the river below the bridge.
>
> The tides reach abovethe bridge, the mean range at the mouth being about 1.6 feett and the stand at high-water is somewhat prolonged probably by the contracted outle, and the bar at the mouth.
>
> The obstructions to the navigation are found in the bar at the mouth in the Rappahannock, and in Booker's Bar, about half way between the bridge and the mouth of the river. The bar is the most serious obstruction, and it is stated by those living near this point that if the bar were removed a draw would be placed in the bridge, which would add 4 miles to the navigation.

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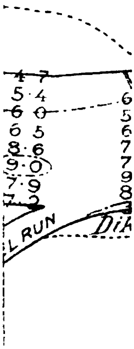

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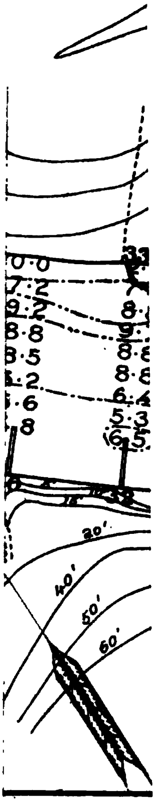

Booker's Bar is 2½ miles below the bridge, and between these points the depth varies from 7½ to 24 feet, shoaling to 3 feet at low-water on the bar. If the bar is regarded as being limited by the curves of 6 feet of depth, it has a length of 2,490 feet. About 750 feet above the bar the river has a width of about 200 feet, which increases to about 900 feet near the middle of the bar, and is reduced to 600 feet at a distance of 650 below it. The channel marked by the curves of 2 feet of depth has a more gradual increase and decrease, the width at the head being 195 feet, at the middle of the bar 482 feet, and at the end about 312 feet. The bar can be further described as occurring at the crossing from the concave channel-way on the right to the concave channel-way on the left, caused by the deflection from the shore.

The bar is composed of soft mud.

Between the bar and the mouth the maximum depth is 22 feet.

The bar at the mouth of the creek in the Rappahannock River, has 1½ feet more water on it than Booker's Bar. The cost and difficulty of improving the channel on the outer bar are considerable. I have, therefore, not included it in my estimate.

The low-water depth on this bar is 4½ feet, which is increased to 6 feet at mean high-water, a depth sufficient for the present needs of navigation.

To correct the effect of Booker's Bar I would propose to dredge a channel through it with a width of 60 feet and a depth of 8 feet permitting the bottom to take the natural slopes, and to construct a dike as indicated by an unbroken line in red on the chart with a length of 2,400 feet.

The dike should have a height not greater than half-tide and should be pervious to water

During the year an examination was made of Booker's Bar, and the following estimates are submitted in lieu of those previously given.

BOOKER'S BAR.

2,400 linear feet of dike, at $4 per foot	$9,600 00
For a channel 60 feet wide and 8 feet deep at low-water:	
25,520 cubic yards of dredging, at 35 cents	8,932 00
	18,532 00
Contingencies, 15 per cent	2,779 80
	21,311 80

BAR AT MOUTH.

For a channel 100 feet wide and 8 feet deep at low-water:	
30,890 cubic yards dredging, at 35 cents	$10,811 50
Contingencies, 15 per cent	1,621 73
	12,433 23
Total for the two bars	33,745 03

The act of June 14, 1880, appropriated $2,500 for the improvement of this river, and the work was assigned to me by the Chief of Engineers June 17, 1880.

It being apparent that the appropriation was too small to be expended economically, no effort was put forth to make the examination, necessary as a basis for a project, and no project was submitted until after the further appropriation of $2,500, by act of March 3, 1881, gave promise of better results from the expenditure of the combined appropriations.

An examination was then made, a project submitted for the construction of a dike at Booker's Bar, specifications were prepared, and the work offered for contract, by public advertisement in the usual way, the proposals to be opened July 9, 1881.

The following appropriations have been made:

June 14, 1880	$2,500
March 3, 1881	2,500

I would respectfully recommend an appropriation of $17,000 for the year ending June 30, 1883.

The work is in the collection district of Tappahannock, which is the nearest port of entry.

The collections in this district for the fiscal year ending June 30, 1881, were $1,177.54.

The nearest light-house is Bowler's Rock, in the fifth light-house district.

Money statement.

July 1, 1880, amount available	$2,500 00	
Amount appropriated by act approved March 3, 1881	2,500 00	
		$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	45 00	
July 1, 1881, outstanding liabilities	9 19	
		54 19
July 1, 1881, amount available		4,945 81
Amount (estimated) required for completion of existing project		29,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		17,000 00

STATISTICS OF TRADE.

There are about 100 square miles of country tributary to the landings on this river, containing a population of about 3,500.

The value of shipments during the year 1880 are estimated at $124,300, and of receipts, $46,000.

The stream is navigable to Totuski Bridge, 5 miles from its mouth, and 3 miles from Warsaw, the county seat of Richmond County.

The entire business of the community is increasing yearly, and Totuski Creek is one of the most important tributaries of the Rappahannock.

H 9.

IMPROVEMENT OF URBANA CREEK VIRGINIA.

HISTORY OF OPERATIONS.

This creek is a tidal tributary of the Rappahannock, taking the character of an estuary, and is really a harbor, and the only harbor on that (the right) side of the Rappahannock for a distance of 60 miles.

A survey was made in December, 1874, a report of which will be found in the report of the Chief of Engineers, 1875, Part I, page 139.

The obstruction to navigation was found to be a bar at its mouth, or strictly a flat of the Rappahannock River, over which the stream makes its way to the main channel of the Rappahannock. The least depth of the water on this flat was 6½ feet.

The landing and town of Urbana, the commerce of which, with its tributary area of country, this improvement was designed to benefit, is situated three-quarters of a mile above the bar.

The project for the improvement was the excavation of a channel through the bar 150 feet wide and 10 feet deep at low-water, at an estimated cost of $20,000.

The first appropriation for the improvement was made March 3, 1879, amounting to $5,000. Under this appropriation a contract was made with Thomas P. Morgan, jr., of Cumberland, Md., for dredging, at 24 cents per cubic yard, in conformity to the project as far as the funds would permit. Work was begun October 18, 1879, and completed February 2, 1880, resulting in securing a channel through the bar 80 feet wide and 10 feet deep. Full details of the work may be found in the report of the Chief of Engineers for the year ending June 30, 1880.

The river and harbor act of June 14, 1880, appropriated $2,500 for continuing the improvement. Proposals for widening the channel were invited in the usual way, and the following bids were received and opened September 11, 1880:

Abstract of proposals for dredging in Urbana Creek, Virginia, opened September 11, 1880

No.	Name and address.	Price per cubic yard.	Time of commencement.	Time of completion.	Number and kind of machine used.	Daily amount of work expected.
						Cu. yds.
1	Daniel Constantine, Baltimore, Md.	$0 33	Jan. 1, 1881	....	One Osgood dredge.	300
2	Henry P. Gilbert, Georgetown, D. C.	40	Spring of 1881, or earlier.	....	One Osgood dredge.	150–300
3	National Dredging Company, Washington, D. C.	30	Early as practicable.	June 30, 1881....	Requisite machinery.	......

The work was awarded to National Dredging Company, at 30 cents per cubic yard, and a contract entered into with them October 6, 1880, the work to be begun by the 1st of March, 1881, and completed on or before June 30, 1881.

At the close of the fiscal year no arrangements had been perfected by the contractors for commencing the work, and 30 days' additional time was granted them.

The river and harbor act of March 3, 1881, appropriated $4,000 for continuing the improvement, and specifications were prepared and proposals invited by advertisement dated June 9, 1881, for widening and deepening the channel through the bar at the mouth of the creek, the proposals to be opened July 9, 1881.

Appropriations have been made as follows:

March 3, 1879	$5,000
June 14, 1880	2,500
March 3, 1881	4,000

For the completion of the work $8,500 will be needed, and I respectfully recommend the appropriation of that sum for the year ending June 30, 1883.

Urbana is a port of entry, and is in the collection district of Tappahannock. The collections for the year ending June 30, 1881, were $1,177.54.

Money statement.

July 1, 1880, amount available	$2,636 66	
Amount appropriated by act approved March 3, 1881	4,000 00	
		$6,636 66
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		60 44
July 1, 1881, amount available		6,576 22
Amount (estimated) required for completion of existing project		8,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		8,500 00

STATISTICS OF TRADE.

The value of shipments for the year 1880 was $219,200, and of the receipts $76,400.

This report, kindly furnished by Mr. T. E. Sutton, was accompanied by the following remarks:

"By the improvement of this creek we develop a country that has been entirely cut off from water communication, a country in which many poor people reside who own vast tracts of forest land, the timber from which might afford them a comfortable support.

"There has just been erected, and is now in successful operation, a large oyster and fruit canning house at this place that must necessarily revive fruit culture.

"Some Philadelphia parties are contemplating the erection of suitable buildings for a summer resort.

"A marine railway is also in contemplation, and it is the intention of those interested to complete it at an early date.

"A petition is now being circulated and signed by vessel-owners, captains, and others interested, to have the custom-house removed from Tappahannock to this place, as being more convenient and accessible, affording a much better harbor, and always free from ice."

H 10.

IMPROVEMENT OF MATTAPONI RIVER, VIRGINIA.

A full description of that portion of the river requiring improvement, about 36 miles in length, and an account of the obstructions to navigation, are contained in the Report of the Chief of Engineers for the year 1879–'80, and may be found in Part I, page 770.

The following table presents a summary of the localities requiring improvement, nature of improvement, and estimate of cost:

Name of locality.	Distance from Mundy's Bridge.	Description of work.	Excavation.	Cost at 40 cents per yard.
	Miles.		*Cu. yds.*	
Pocket Bend Cut-off	12½	Closing channel		$1,000
Second Cut-off	15	do		500
Removing logs, trees, and drift as far as Aylett's.	26	Removing snags, &c		7,800
Wreck at Aylett's	26	Removing wreck		250
Old Hall Bar	27	Dredging	6,666	2,667
Wreck below Aylett's	27½	Removing wreck		300
Walker's Bar	32	Dredging	7.407	2,963
Sale's Bar	32½	do	5,925	2,371
Presque Isle Bar	33	do	10,066	4,266
Between Presque Isle and Robinson's		Removing snags, &c		250
Robinson's Bar	35	Dredging	8,888	3,555
Pointer's or Latane's Bar	38	do	7,111	2,844
Line Tree Bar	38¾	do	4,742	1,897
At other points		Snags, &c		300
				30,963
Add for contingencies 10 per cent				3,096
Total				34,059

The distances are only approximately correct.

The dredging is intended to give 4½ feet on all the bars at extreme low-water, 5½ feet at ordinary low-water, and from 7½ to 8½ feet at high-water.

The river and harbor act of June 14, 1880, appropriated $2,500 for the improvement, being the first appropriation for this river, and the work was assigned to me by the Chief of Engineers June 17, 1880.

The project for the improvement, which was approved October 1, 1880, contemplated the removal of all such obstructions as wrecks, snags, logs, and overhanging trees, before attempting any dredging operations; the work to be done by hired labor under an overseer, and with the plant used for like purposes on the Pamunkey River.

WORK OF THE PAST FISCAL YEAR.

The river and harbor act of March 3, 1881, appropriated $3,300 for continuing the improvement. It was then seen that, with the increased funds available for the two rivers, Mattaponi and Pamunkey, the work on Mattaponi could not be accomplished without unreasonable delay on the plan projected under the previous appropriation, namely, by using the Pamunkey plant after that work should have been completed. It was therefore recommended and approved that a separate plant, similar to that on the Pamunkey, be constructed, that the work might proceed without delay.

Accordingly, materials were purchased in open market, and the plant built by hired labor at New Castle Landing, on the Pamunkey River, there being facilities at that place which could not be found on the Mattaponi.

At the end of the fiscal year the plant, consisting of derrick, derrick-boat, quarter-boat, scow, and small canoes, together with the necessary tools and appliances, was ready for work, and instructions were given to take it around by West Point up the Mattaponi, and begin operations at Aylett's, working up stream, and removing all snags, drift logs, overhanging trees, &c., found to obstruct the channel.

Appropriations have been made as follows:

June 14, 1880	$2,500
March 3, 1881	3,300

The amount needed to complete the improvement is $28,300.

I respectfully recommend that $10,000 be appropriated for the year ending June 30, 1883.

The work is in the collection district of Yorktown, which is the nearest port of entry. The collections for the year ending June 30, 1881, were $1,186.08.

The nearest light-house is Bell Rock, in the fifth light-house district.

Money statement.

July 1, 1880, amount available	$2,500 00	
Amount appropriated by act approved March 3, 1881	3,300 00	
		$5,800 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		1,444 09
July 1, 1881, amount available		4,355 91
Amount (estimated) required for completion of existing project		28,300 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		10,000 00

H 11.

IMPROVEMENT OF PAMUNKEY RIVER, VIRGINIA.

A detailed description of that portion of the river, about 30 miles in length, which requires improvement, with an account of the obstructions to navigation, may be found in the report of the Chief of Engineers for the year 1879–'80, Part I, p. 773.

The localities requiring improvement, nature of improvement, and estimates of cost, are summarized in the following table:

Approximate estimate.

[The distance in miles is reckoned from Hanovertown, and is estimated, not measured.]

Localities.	Distance in miles.	Cost of removing—		Dredging.		Total cost.
		Wrecks.	Logs, snags, &c.	Cubic yards.	Cost at 45 cents per yard.	
Potomoy Creek	4			2,600	$1,170	$1,170
Dr. Wormley's Landing	5		$1,000			1,000
Whale's Back Bar	5¾			2,700	1,215	1,215
New Castle Ferry	9		800			800
Skidmore's Bar, or Upper Basset	13		400	2,700	1,215	1,615
Bassett's Ferry	14					
Bassett's Bar	14½	$3,000		2,800	1,260	4,260
Carter's Island	18	1,600	300			1,900
Spring Bar	19¾			3,400	1,530	1,530
Piping Tree	28		300			300
Garlic's Bar	31	800				800
Mouth of river	80					
Aggregate		5,400	2,800	14,200	6,390	14,590
Add 20 per cent. for contingencies						2,918
Total estimate						17,508

WORK OF THE PAST FISCAL YEAR.

The river and harbor act of June 14, 1880, appropriated $2,500 to this improvement, being the first appropriation, and the work was assigned to me by the Chief of Engineers June 17, 1880.

The project for the improvement, approved October 1, 1880, was as follows:

To purchase in open market the necessary snagging equipment and material for building a derrick-boat, quarter-boat, scows, &c., and to build the boat, and remove by hired labor, under an overseer, such obstructions as wrecks, snags, logs, and overhanging trees.

A plan for derrick-boat and derrick was prepared, and proposals invited for lumber, materials, and tools.

Great difficulty was experienced in getting bids for an amount of lumber so small and of special dimensions, but a contract was made and the lumber inspected in December, when it was found that a great portion of it failed to conform to the specifications either in quality or dimensions, and the remainder of the month was consumed in making good the deficiencies, when the severe weather began which put an end to all further operations. It was not until March, 1881, that the overseer was placed on duty again.

On the 28th of April, the derrick, derrick-boat, quarter-boat, and scow having been completed, snagging operations were begun at Hanovertown (or Dabney's ferry) and prosecuted without interruption till the close of the fiscal year, when the following work had been done:

Miles of river cleared of obstructions		4
Snags removed:		
Number		479
Total length	feet..	11,679
Average diameter	inches..	12.6
Drift logs removed:		
Number		119
Total length	feet..	1,561
Average diameter	inches..	13.3
Trees felled:		
Number		225
Average diameter	inches..	11¼

It is believed that the portion of the river next below this work contains fewer obstructions of this class as the distance from the point of beginning increases.

The appropriation of $2,500, by act of March 3, 1880, will be applied to continuing snagging operations in the same way.

Appropriations have been made as follows:

June 14, 1880	$2,500
March 3, 1881	2,500

The amount required for the completion of the existing project is $12,500, all of which can be profitably expended in the year ending June 30, 1883, as the greater part of it will be expended by contract in dredging. I therefore respectfully recommend that that sum be appropriated.

The work is in the collection district of Yorktown, which is the nearest port of entry. The collections for the year ending June 30, 1881, were $1,186.08.

The nearest light-house is Bell Rock, in the fifth light-house district.

Money statement.

July 1, 1880, amount available	$2,500 00	
Amount appropriated by act approved March 3, 1881	2,500 00	
		$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,448 81
July 1, 1881, amount available		2,551 19
Amount (estimated) required for completion of existing project		12,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		12,500 00

H 12.

IMPROVEMENT OF YORK RIVER, VIRGINIA.

A survey of the bars forming the obstructions to the navigation of this river was made in 1879 by Capt. Chas. B. Phillips, whose report and estimate for the improvement may be found in the report of the Chief of Engineers for the year ending June 30, 1880, Appendix I, p. 18.

The project for the improvement was the excavation of channels 22 feet deep and 200 feet wide through the bars at West Point and Potopotank, with an increased width at the wharves at West Point.

WORK OF THE PAST FISCAL YEAR.

The first appropriation for this improvement was made in the river and harbor act of June 14, 1880, the amount being $10,000.

This amount being insufficient to effect a satisfactory improvement through the bars at West Point, the recommendation that it be applied to the improvement of the bar at Potopotank Creek was approved, and, after the usual advertisement, bids as follows were received and opened September 11, 1880, for dredging a channel through Potopotank Bar 22 feet deep and as wide as the funds would permit.

Abstract of proposals for dredging in York River, Virginia, opened September 11, 1880.

No.	Name and ddress.	Price per cubic yard.	Time of commencement.	Time of completion.	Number and kinds of machines used.
1	H. F. Culpepper, Portsmouth, Va.	*$0 19¾ †24¾	Oct. 15, 1880.	June 30, 1881.	One or more Osgood dredges.
2	G. H. Ferris, Baltimore, Md.	21	Dec. 15, 1880.	July 1, 1881.	All machinery required.
3	National Dredging Company, Washington, D. C.	15	As early as practicable.	June 30, 1881.	Requisite machinery.
4	Geo. C. Fobes & Company, Baltimore, Md.	‡15 §18	Between Oct. 15 and Nov. 1, 1880.	June, 30, 1881.	One or more clam-shell dredges.

* For material moved 5 miles or less. † For material moved over 5 miles.
‡ For material moved average distance of 6 miles. § For material moved distance of 7 to 12 miles.

The award of work was made to the National Dredging Company at 15 cents per cubic yard, and the contract was entered into October 6, 1880, the work to be begun on or before the 1st of March, 1881, and completed on or before June 30, 1881.

The contractors reported their readiness to begin on the 29th of November, 1880.

A party was sent down to lay out the work and an inspector provided, but the contractor's plant did not appear till the 16th of December, though inspected daily, being prevented by rough weather from transferring their machine from the Delaware River. A further delay, waiting for coal, till the 28th of December, followed. Three days' work was then accomplished, followed by a suspension for seven days on account of running ice. From the 18th of January up to January 31, more or less work was done every day, but great difficulty was experienced in keeping ranges in position, and frequent delays were caused by the necessity of suspending work till they could be replaced. From this time to February 11 no work was done, owing to ice and stormy weather, after which time the delays were less frequent, and fair progress was made until the contract was completed on the 31st of March, 1881, 58,809 cubic yards having been taken out, at 15 cents per cubic yard.

The result of the work was a channel through Potopotank Bar, 105 feet wide and 22 feet deep at low-water, which is all the improvement that will be required at this locality at present.

The river and harbor act of March 3, 1881, appropriated $25,000 for the improvement at West Point.

Specifications were prepared and proposals invited by public advertisement dated June 9, 1881, the proposals to be opened July 9, 1881.

Appropriations have been made as follows:

June 14, 1880	$10,000
March 3, 1881	25,000

The amount required for the completion of the improvement is $93,000, and I respectfully recommend that $50,000 be appropriated for the year ending June 30, 1883.

York River is in the collection district of Yorktown, which is the nearest port of entry.

The collections for the year ending June 30, 1881, were $1,186.08.

The nearest light-house is Bell Rock in the fifth light-house district.

Money statement.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	25,000 00	
		$35,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	10,853 12	
July 1, 1881, outstanding liabilities	48 00	
		10,901 12
July 1, 1881, amount available		24,098 88
Amount (estimated) required for completion of existing project		93,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		50,000 00

STATISTICS OF TRADE.

The value of shipments at West Point during the year 1880, by water, was $30,569,567.80, and of receipts $6,911,862.32.

Vessels engaged in trade during the year 1880.

Description.	Departures.			Arrivals.		
	No.	Total tons.	Greatest draught.	No.	Total tons.	Greatest draught.
			Feet.			*Feet.*
Steam	512	51,968.53	19½	512	34,645.69	19½
Sail	260	65,000 00	14	260	Light.	

Sail vessels arrive light for wood, ties, and lumber.

Average value of each cargo delivered	$59,706 18
Average value of each cargo received	13,500 60

H 13.

IMPROVEMENT OF CHICKAHOMINY RIVER, VIRGINIA.

HISTORY OF OPERATIONS.

The first appropriation for the improvement of this river was made June 18, 1878, amounting to $5,000.

The obstruction to navigation consisted of three bars, Binn's, Old Fort, and Windsor Shoals, from 23 to 25 miles above the mouth of the river.

Under this appropriation channels 60 feet wide and 8 feet deep at low-water were dredged through Windsor Shoals and Old Fort Bars, and a channel 100 feet wide and 8 feet deep at low-water through Binn's Bar. This work was completed May 5, 1879.

The next appropriation was made March 3, 1879, but was so small in amount ($1,000) that no improvement could be economically effected. Its expenditure was therefore deferred, and the reason therefor fully stated in the last annual report.

WORK OF THE PAST FISCAL YEAR.

The river and harbor act of June 14, 1880, appropriated $2,000 for continuing operations. This, with the previous unexpended appropriation, made an available sum at the beginning of the fiscal year of $3,000.

Proposals were invited for widening the channels through the three bars, and the following bids were received, and opened September 11, 1880:

Abstract of proposals for dredging in Chickahominy River, Virginia; opened September 11, 1880.

No.	Name and address.	Price per cubic yard.	Time of commencement.	Time of completion.	Number and kinds of machines used.	Daily amount of work expected.
						Cu. yds.
1	H. E. Culpepper, Portsmouth, Va.	$0 14.9	Nov. 5, 1880 ...	Apr. 30, 1881	1 or more Osgood dredges.	....
2	G. H. Ferris, Baltimore, Md ..	*16 †18	Jan. 1, 1881....	July 1, 1881		
3	Alfred Kishpaugh, Fredericksburg, Va.	35	First week in April, 1881.	....	1 dipper dredge...	....
4	Henry P. Gilbert, Georgetown, D. C.	*21 †25	As early as practicable.	June 30, 1881	1 Osgood dredge..	250–400
5	National Dredging Company, Washington, D. C.	18	As early as practicable.	June 30, 1881	Necessary machinery.	....

* For Binn's Bar only.
† For Old Fort and Windsor Shoals Bars.

The work was awarded to H. E. Culpepper, of Portsmouth, Va., at 14.9 cents per cubic yard, and the contract was entered into September 27, 1880.

Work was begun November 13, 1880, at Binn's Bar, and completed December 16, 1880, when 10,000 cubic yards had been removed, securing an additional width of 100 feet to the channel dredged in 1879, making the channel now 200 feet wide, and 8 feet deep at low-water.

At Old Fort Bar work was commenced December 17, 1880, and completed December 27, 1880. The channel which was dredged in 1879, 60 feet wide and 8 feet deep, was widened to 100 feet, 2,440 cubic yards having been removed.

The contractor's plant was removed to Windsor Shades Bar, but before operations could be begun, ice formed over the river, and caused suspension of work until January 31, 1881, when two days' work was done, and the work again suspended by ice in the river.

Work was again resumed on the 8th of February, and continued till the 18th of February, when the work at Windsor Shades Bar was completed.

The channel, which was dredged in 1879 to a width of 60 feet, and depth of 8 feet at low-water, was widened to 100 feet, 4,493 cubic yards having been removed.

The river and harbor act of March 3, 1881, appropriated $2,000 for continuing the improvement.

The work remaining to be done is the construction of dikes to close several subsidiary channels, and the removal of snags and drifts at points above the improved bars.

The amount available is too small to economically put to contract the construction of dikes, or to justify the construction of such a plant as would be required for executing the work by hired labor without assurances of further appropriation.

The removal of snags, drift, &c., being work of such a nature as is difficult to specify, except at a disproportionate expense for the necessary minute surveys and estimates, can be most economically and satisfactorily done by hired labor, with a plant designed for such work.

As two such plants have been constructed by me during the year, for use on the Mattaponi and Pamunkey Rivers, it is respectfully recommended that the entire sum, $5,000, needed for the completion of this work, be appropriated for the year ending June 30, 1883, and that one, or both of the plants mentioned be transferred to the Chickahominy on the completion of the work for which they were built, or whenever funds are not available, to keep them in operation, and complete the improvement of Chickahominy by their use with hired labor.

Appropriations have been made as follows:

June 18, 1878	$5,000
March 3, 1879	1,000
June 14, 1880	2,000
March 3, 1881	2,000

The work is in the collection district of Richmond, which is the nearest port of entry.

The collections for the year ending June 30, 1881, were $19,397.93.

The nearest light-house is Deep Water Shoal light-house, in the fifth light-house district.

Money statement.

July 1, 1880, amount available	$3,000 00	
Amount appropriated by act approved March 3, 1881	2,000 00	
		$5,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		2,976 35
July 1, 1881, amount available		2,023 65
Amount (estimated) required for completion of existing project		5,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		5,000 00

STATISTICS OF TRADE.

The shipments from this river for the year 1880 amounted in value to $844,000, and the receipts to $430,500. Mr. C. Perkins, of Providence Forge, to whom I am indebted for these statistics, adds, that "the removal of obstructions and drainage is very much needed in the upper tributaries of the stream."

H 14.

IMPROVEMENT OF STAUNTON RIVER, VIRGINIA.

HISTORY OF THE IMPROVEMENT.

An examination of the river between Brookneal and Roanoke Station was made in 1878, in obedience to the instructions of the Chief of Engineers, and my report may be found in his report for 1879, p. 621.

The first appropriation for improvement was made March 3, 1879, when $5,000 was appropriated.

A survey was necessary before plans for improvement could be prepared, and the survey was made in October and November, 1879, a report of which, with estimates in detail, may be found in the report of the Chief of Engineers for 1880, p. 780.

The project for the improvement was to provide a channel through the bars and ledges, not less than 35 feet wide and 2 feet deep at low-water; the improvement to be effected by blasting rock, and by removing sand-bars by means of spur dikes of crib-work filled with stone, for contracting the water-way. At the close of the fiscal year ending June 30, 1880, all the plant necessary for beginning the improvement had been provided. A derrick, derrick-boat, quarter-boat, and stone scows were built by hired labor, and with tools and materials purchased in open market.

WORK OF THE PAST FISCAL YEAR.

The work of quarrying stone was begun in July, near Clark's Dam, and continued till August 19, when 812 cubic yards had been quarried and placed near the river bank. On the 20th of August the work of blasting rock from the channel was begun at Hawk Mountain.

Much high water prevailed after this time, and the work was greatly hindered and frequently suspended on that account.

But the scarcity of labor at the season when the tobacco crop demanded all that the country could afford was a source of still greater annoyance and hinderance. The men were either under contract with planters to attend their crops when wanted, or if not under contract, the fear of retaliation by non-employment when work on the improvement was not in progress, operated with all the cogency of a contract. In many instances the laborers had little plantings of their own, which must have prompt attention, or the whole be lost.

Some tact was necessary to so adjust the wages offered as not to incur the hostility of the planters, whose temporary interests at this juncture were deemed by them of more importance than a rigorous prosecution of the work. And it seemed proper that they should be consulted in this adjustment, on the principle that the spirit of that legislation which is designed to promote the interests of a community would forbid that it should be so executed as to cancel the benefits designed to be conferred by the infliction of injuries in the manner of its execution.

The water becoming too cold to work in it to advantage, work was suspended October 30, 1880, the tools and materials were stored at Hawk Mountain, and the boats taken down to Little Roanoke River, moored therein and placed in charge of a watchman, who was required to remain upon them day and night.

Seven hundred and seventy-eight cubic yards of rock were removed from the channel during the season.

Work was resumed on the 24th of May, 1881, at Hawk Mountain.

At the close of the fiscal year there had been removed—

Loose rock	cubic yards..	461
Blasted rock	do....	845
Number of holes drilled	do....	1,237
Total length of holes drilled	feet..	2,140
Number of giant-powder cartridges used (usually in half cartridges) or 255 pounds		765½
Number of platinum fuses used		1,362

There were but three days during this period when no work was done.

The river and harbor act of March 3, 1881, appropriated $5,000 for continuing the improvement. It is proposed to expend this money with the unexpended portion of the appropriation of 1880, by completing Hawk Mountain improvement; continuing the blasting of rock through Horseback Shoal, and the construction of such spur dikes below Hawk Mountain as may be needed to deepen the channel over sand bars, and regulate the incline of water surface at rapids.

The amount needed to complete the improvement is $40,170, and I would respectfully recommend an appropriation of $15,000 for the year ending June 30, 1883.

The following appropriations have been made:

March 3, 1879	$5,000
June 14, 1880	7,500
March 3, 1881	5,000

Money statement.

July 1, 1880, amount available	$8,602 38	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$13,602 38
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		4,636 75
July 1, 1881, amount available		8,965 63
Amount (estimated) required for completion of existing project		40,170 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		15,000 00

H 15.

IMPROVEMENT OF DAN RIVER, VIRGINIA AND NORTH CAROLINA.

HISTORY OF THE IMPROVEMENT.

A survey of the portion of Dan River between Danbury, N. C., and Danville, Va., a distance of about 77½ miles, was made in 1879, and the report with estimates for its improvement for bateau navigation, and also for steam navigation by means of locks and dams, may be found in Appendix G 19, Report of Chief of Engineers for 1879; and in Appendix H 15 of the Report of 1880, a modification will be found of the estimate for steam navigation, based upon a depth of 3 feet of water, for six months of the year.

The river and harbor act of June 14, 1880, appropriated $10,000 for improving Dan River between Danville, Va., and Madison, N. C.

The project for the work was in accordance with the estimate above referred to, and contemplated a channel 35 feet wide through ledges, with a depth of excavation of 1½ feet in pools and 2 feet on rapids, and a maximum slope on rapids of 10 feet to the mile, which it is proposed to overcome, if found necessary, by the use of cables anchored at the head of the comparatively short incline.

This project, it is believed, will give 3 feet of water for six months of the year.

It was proposed to accomplish the work by the purchase of tools and materials; the construction of derrick-boats, and stone scows, by hired labor, and having thus provided the plant, to execute the work by hired labor, under overseers.

The project was approved July 13, 1880, and proposals were invited for supplying materials and tools for the work.

These having been purchased, work was commenced on the derricks and boats on the 21st of September. One derrick-boat and one scow were completed October 16, and work was begun in excavating rock from the channel October 21. The second derrick-boat and scow were completed November 3, 1880.

Only 50 cubic yards of rock had been blasted when the coldness of the water prevented the continuance of rock excavation after the 30th October, and the work was suspended for the winter.

Work was resumed on the 20th of May, 1881, and was continued with only moderate progress on account of the hardness of the rock and the unfavorable directions of its seams, which prevented effective blasts. During the year there were removed—

Loose rock	cubic yards	24
Blasted rock	do	281
Sand and gravel	do	91
Number of holes drilled	do	710
Total length of holes drilled	feet	1,262.6
Giant powder used	pounds	234
Platinum fuses used		642
Gold-leaf fuses used		44

Appropriations have been made as follows:

June 14, 1880	$10,000
March 3, 1881	8,000

The amount needed for the completion of the work is $34,000.

I would respectfully recommend an appropriation of $15,000 for the year ending June 30, 1883.

Money statement.

July 1, 1880, amount available	$10,000 00	
Amount appropriated by act approved March 3, 1881	8,000 00	
		$18,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		4,989 11
July 1, 1881, amount available		13,010 89
Amount (estimated) required for completion of existing project		34,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		15,000 00

H 16.

IMPROVEMENT OF FRENCH BROAD RIVER, NORTH CAROLINA.

HISTORY OF THE IMPROVEMENT.

The river and harbor act of August 14, 1876, contained the first appropriation for improving French Broad River, the amount being $10,000.

Under this appropriation a survey was made in July, August, and September, 1877, the report of which, with estimates, may be found in the report of the Chief of Engineers for 1878, Part I, p. 525.

The estimated cost of improving the 32 miles of river from Brevard to Big Buck Shoal, so as to secure a channel 2½ feet deep at low-water and 35 feet wide, was $45,500.

The improvement was begun in October, 1877, by hired labor; the work, owing to the advance of the working season, being restricted to the removal of snags, drift, and overhanging trees.

In the spring of 1878 this work was resumed and rock also quarried for the construction of dams to graduate the slope of water surface at Davidson's River Shoal, and sixteen dams were built for that purpose.

The required dimensions of channel were secured as far down as Patton's Shoal, where dredging (gravel) was begun, and rock excavation at Cherokee Shoal, also in progress, when the approach of cold weather caused the suspension of the work for the season.

The quarrying of stone, however, for the improvement of the shoals last mentioned, was continued through the winter.

Work at Patton's Shoal was resumed May 5, 1879, where eight wing-dams were built, and the improvement completed June 7.

Excavation at Allison's Shoal was begun May 23, and completed June 18.

Excavation of rock at Cherokee Shoal was continued; nineteen wing-dams built, and the improvement completed September 13.

Rock excavation at Little Buck Shoal was commenced July 7, and the improvement, including the construction of fourteen wing-dams, was completed October 15.

Three wing-dams were built at Allison's Shoal; several small shoals between Brevard and Davidson's River were dredged, and some rock removed therefrom; a channel at Wilson's Fish-trap excavated through rock; a channel dredged at Old Ford, near Shuford's Bridge, and some rock excavation effected at Clayton's Reef.

The banks at various points were protected by means of stone and brush.

November 15, operations were suspended for the winter, 10½ miles of the river having been made navigable, and the most important obstructions removed.

In 1880 stone was quarried at Nelson's and at Sitton's Bluff for the construction of dams at Spann's Shoal; new scows built, old scows, boats, and derricks repaired, and at the close of the fiscal year work was in progress, in dredging and rock excavation, at Spann's Shoal, Henry's Fish-trap, Bowman's Bluff, County Line, and Clayton's Reef.

WORK OF THE PAST FISCAL YEAR.

The gravel excavation at Willow Creek, and rock excavation at Henry's Fish-trap, Bowman's Bluff, Sitton's Bluff, Spann's Shoal, and at five other points of less importance had been completed, and work was in progress at the shoal below Mud Creek and at Long Shoal below Cain Creek, when, the funds being nearly exhausted (only enough remaining to pay watchman's wages through the winter and contingencies of care of property), work was suspended September 4, 1880, and the boats, tools, and other government property placed in charge of a watchman.

Under the appropriation of $5,000 in the river and harbor act of March 3, 1880, work was resumed June 15, 1881.

At the close of the fiscal year the work had been confined to going over the improvement of the previous years, repairing dams, redredging gravel bars, protecting banks, removing drifts, and taking out such points of rock as had escaped notice before.

The following is a summary of work done during the year:

Length of river improved	miles	16
Localities worked at		13
Loose rock removed	cubic yards	82
Blasted rock removed	do	575
Sand and gravel removed	do	2, 215
Number of holes drilled		1, 400
Total length of holes	feet	2, 451
Giant powder used	pounds	363
Exploders used		1, 466

	Number.	Length.	Average diameter.
		Feet.	*Inches.*
Snags removed	115	2, 698	13½
Drift logs removed	38	567	13¼
Trees felled	17		13

Appropriations have been made as follows:

August 14, 1876	$10,000
June 18, 1878	15,000
March 3, 1879	5 000
June 14, 1880	3,000
March 3, 1881	5,000

For the completion of the work $17,000 will be required, which I respectfully recommend be appropriated for the fiscal year ending June 30, 1883.

Money statement.

July 1, 1880, amount available	$4,258 12	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$9, 258 12
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		5, 272 23
July 1, 1881, amount available		3, 985 89
Amount (estimated) required for completion of existing project		17, 000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		17, 000 00

STATISTICS OF TRADE.

The traffic of the country tributary to the French Broad is estimated at $3,816,000.

The products of the country are represented to have increased 25 per cent. within two years, and the value of real estate to have appreciated 25 per cent. within the same period. A steamer for traffic on the river is being built and will be launched early in July.

H 17.

IMPROVEMENT OF ROANOKE RIVER, NORTH CAROLINA.

No funds have been available during the past fiscal year.

In Appendix G 14, Report of Chief of Engineers for 1879, may be found a summary of operations previous to that time, to which I respectfully refer.

The estimates under which these operations were conducted, and others proposed, being based upon a reconnaissance made in 1871, I would renew my recommendation of last year, that a survey be made, to ascertain the changes that have taken place in the bars since that date, and that for the removal of snags. and the repair of the dike at McCree's Landing, an appropriation of $5,000 be made for the year ending June 30, 1883.

Appropriations have been made as follows:

March 3, 1871	$20,000
June 10, 1872	10,000
March 3, 1873	10,000
June 23, 1874	5,000

The work is in the collection district of Edenton, which is the nearest port of entry.
The collections for the year ending June 30, 1881, were $1,805.55.
The nearest light-house is Edenton range lights, in the fifth light-house district.

Money statement.

Amount that can be profitably expended in fiscal year ending June 30, 1883.	$5,000 00

H 18.

SURVEY OF POTOMAC RIVER AT THE MOUTH OF POHICK CREEK.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., January 7, 1881.

GENERAL: I have the honor to submit the following report upon a survey of the Potomac River near the mouth of Pohick Creek, Virginia, made during the month of August, 1880. This survey was provided for in the act of appropriations for rivers and harbors, approved June 14, 1880, and assigned to me by your letter of June 17, 1880.

Pohick Creek unites with Accotink Creek in forming Gunston's Cove, an estuary of the Potomac River, about 18 miles below Washington City. The residents desire an improvement of the channel from the Potomac River to Gunston's Wharf, a distance of 3,400 feet.

The petitioners for this improvement are residents of a tract of country known as Mason's Neck, comprising about 14,000 acres of land, one-half of which is well timbered and possesses a productive soil. It is situated in Fairfax County, Virginia, and in the collection district of Alexandria. Gunston Hall, the old seat of the Mason family, is in fair preservation, and is now used as a dwelling and post-office. The soil is well cultivated and the crops of cereals and fruit are abundant. Products are shipped and freights are received by the steamer W. W. Corcoran, which carries the daily mail, but owing to the low tides caused by the winds difficulty is experienced in reaching the landing at Gunston's Wharf. The steamer approaches the landing over flats which have a uniform depth of 5½ feet at mean low-tide.

An improved channel from 8 to 9 feet deep and 150 feet wide would meet the requirements of trade and satisfy the wishes of those interested. A channel of less dimensions would add to the facility of reaching the wharf, but would fill so soon after the completion that economy would be best subserved by adopting the dimensions mentioned above.

An estimate of the cost of dredging such a channel is given below, and its position is indicated by dotted lines upon the accompanying map. The material to be excavated is soft mud.

Much of the wood and lumber of this section is shipped by means of long-boats which take advantage of the tide to go up Pohick Bay for a distance of about 2 miles.

No appropriation is asked for the improvement of the bay above Gunston's Wharf, but the following information which may be useful at some future day is submitted:

Value of land near Pohick Bay varies from $5 to $10 per acre; upon Accotink Creek the value of land varies from $10 to $50 per acre; 400,000 to 500,000 feet of lumber are rafted from Pohich to Troth's Mills, on the Accotink, and is then sawed and shipped.

From 1,000 to 2,000 cords of wood are shipped from Pohick annually by means of long-boats, besides an unknown quantity of hoops and staves. Judge Edmond's fisheries upon the banks of Pohick formerly rented for $500 per annum, but now rent for $20; Otterbach's fisheries are not now rented or used.

ESTIMATE OF THE COST OF DREDGING A CHANNEL FROM THE POTOMAC RIVER TO GUNSTON'S WHARF WITH A DEPTH OF 8 TO 9 FEET AND A WIDTH OF 150 FEET, AND INCLUDING 20 PER CENT. FOR THE REFLOW OF THE SOFT MATERIAL FROM THE SIDES OF THE CUT.

93,400 cubic yards, at 20 cents per yard	$18,680
Add 10 per cent. for contingencies	1,868
Total	20,548

TRADE, SHIPMENTS, AND RECEIPTS.

Number of passengers to and from Gunston's Wharf for the year	2,000
Value of grain and fruit exports	$20,000
Fertilizers received	15,000

Tide-gauges were left at Gunston's Wharf and at Brick-yard Wharf, the zero of which corresponds with mean low-water as determined by the survey, which was probably too short a period for the proper determination of the mean low-water for the year. Maximum velocity of tide observed was 0.13 mile per hour.

* * * * * * *

Very respectfully, your obedient servant,

S. T. ABERT,
United States Civil Engineer.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

H 19.

SURVEY OF MOUTH OF CURRIOMAN BAY, VIRGINIA.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., January 7, 1881.

GENERAL: I have the honor to submit the following report of a survey of Currioman Bay, made during the month of September, 1880, in accordance with a provision in the act of appropriation for rivers and harbors, approved June 14, 1880, and assigned to me by your letter of June 17, 1880.

Currioman Bay is an estuary of the Potomac River, situated in Westmoreland County, Virginia, in the collection district of Tappahannock, and about 82 miles below the city of Washington. Its length from the head of the bay to the channel at its mouth is about 3 miles, and its average width is three-fourths of a mile.

Freight is shipped from a wharf 2½ miles from the mouth. After passing the bar, in ascending the channel the basin deepens from 9 to 10 feet, and shoals again to 7 feet near the landing. The depth on the bar at mean low-water is 7.5 feet; which is reduced by northwest winds to 6.5 feet. Four steamers ply to the bay—three from Washington and one from Baltimore. Sailing vessels drawing from 7 to 8 feet come to the same landing.

The farmers and shippers living in the vicinity of the landing, including those living on Nomini Creek, are now displaying much business activity. About 10,000 barrels of oysters, and large quantities of grain, and many cattle, 20,000 tons of ship-timber, and 80,000 feet of sawed lumber are shipped annually to northern ports. * * *

To meet the requirements of the growing trade it is proposed to dredge a channel through the bar above mentioned 2,050 feet long, 150 feet wide, and 11 feet deep at low-water. About half-way between the mouth and the wharf a bar makes out which the pilots desire to have buoyed, but the channel to the north of it appears to be sufficiently wide. No appropriation was made for an examination of the shoal water at the wharf.

ESTIMATE FOR A CHANNEL THROUGH THE BAR 2,050 FEET LONG, 150 FEET WIDE, AND 11 FEET DEEP.

30,100 cubic yards at 25 cents per yard	$7,525
Add 10 per cent. for contingencies	753
Total	8,278

The tide-gauge for reducing the soundings was established at Bushfield Wharf, in Nomini River, but the soundings were reduced $\frac{5}{10}$ below the zero of the gauge; the time occupied in making the survey being thought too short for the correct determination of the plane of mean low-water.

* * * * * * *

Very respectfully, your obedient servant,

S. T. ABERT,
United States Civil Engineer.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

APPENDIX I.

IMPROVEMENT OF THE HARBORS OF NORFOLK, VA., AND BEAUFORT, N. C.; OF CURRITUCK SOUND, COANJOK BAY, AND NORTH RIVER AND BAR, AND OF CERTAIN RIVERS IN VIRGINIA AND IN NORTH CAROLINA AND SOUTH CAROLINA.

REPORT OF CAPTAIN JAMES MERCUR, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1881, *WITH OTHER DOCUMENTS RELATING TO THE WORKS.*

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., July 25, 1881.

GENERAL: I have the honor to transmit herewith annual reports upon the works of river and harbor improvement under my charge for the fiscal year ending June 30, 1881.

These works were previous to and at the date of his death, June 14, 1881, under charge of Capt. Charles B. Phillips, Corps of Engineers, and all work done upon them up to that date was under his direction.

Very respectfully, your obedient servant,

JAMES MERCUR,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

I 1.

IMPROVEMENT OF NORFOLK HARBOR, VIRGINIA, AND ITS APPROACHES.

The object of this important improvement has been fully set forth in previous annual reports, and is, in brief, to secure a channel not less than 25 feet in depth and 500 feet in width, at ordinary low-water, from the deep water of Hampton Roads to Norfolk Harbor and to the United States Navy-yard at Gosport immediately above, on the south branch of the Elizabeth River; to improve the harbor proper by dredging at the mouth of the eastern branch, and to dredge off the slopes of the Portsmouth and Berkley Flats, in order to restore the cross-sectional area and anchorage grounds, which have been lost during recent years. The first appropriation (August 14, 1876, $35,000) was devoted to dredging in the eastern branch of the Elizabeth River, a portion of the inner harbor which was then most in need of improvement.

The next appropriation (June 18, 1878, $50,000) was devoted to giving increased width to the channels in the eastern and southern branches, and to securing, in part, 25 feet of water across the bar off the mouth of the western branch.

The appropriation of March 3, 1879, $75,000, was devoted to widening the dredged channel through the bar off western branch and to dredging off the Portsmouth Flats.

For details of the work under these appropriations, reference is requested to annual reports of the Chief of Engineers for 1877, 1879, and 1880.

The contract under act of March 3, 1879, should have been completed by June 30, 1880, but some of the work in the vicinity of the Portsmouth Flats requiring more time for its execution than was anticipated, the contractors (Messrs. Morris and Cumings) asked for and were granted an extension, by authority of the Chief of Engineers, dated June 21, 1880. Under this extension they worked from June 30 to August 11, when, the available funds being nearly exhausted, operations were suspended.

During this time they removed from the Portsmouth Flats and the vicinity of the wharves adjoining, 64,385 cubic yards of material and 150 scow loads of old piles, wharf debris, old ballast, &c.

The act of Congress of June 14, 1880, appropriated $50,000 for this work. A project for the expenditure of this sum was submitted to the Chief of Engineers, June 24. This project, which contemplated the furtherance of the general plan of improvement proposed, having been approved by the Chief of Engineers, proposals were invited for the removal by dredging of 350,000 cubic yards of material, more or less.

These proposals were opened September 4. The lowest bidders were Messrs. Pardessus & Anthony of New York, at 9½ cents per cubic yard, with whom a contract was entered into for the removal of material as proposed.

Operations were commenced October 8, in the bar off western branch, and continued there until November 8, when the work required at that place being accomplished, the machine was moved to the bar between Craney Island and Sewall's Point, which will be hereafter designated as Sewall's Point Bar, as it extends beyond that point and ends at the deep water of Hampton Roads.

At this bar dredging was commenced on November 12, and continued until December 10, when the weather being very stormy and the position quite exposed, the contractors were allowed to withdraw the machine and wait for more favorable weather.

During January, 1881, it became evident that, unaided, the contractors would be unable to comply with the terms of their contract. They obtained assistance from the National Dredging Company, to the general manager of which, Mr. F. B. Colton, they gave power of attorney to collect moneys which might become due in the further execution of the contract. This proceeding was approved by the Chief of Engineers and the power of attorney duly filed with the proper accounting officers of the Treasury Department.

The work was resumed in Sewall's Point Bar, February 14, with one dredge, supplemented by a second on the 18th of the same month.

The two dredges worked until March 31, when one was withdrawn, and the work has since been prosecuted by one dredge.

The amount of material removed under the existing contract is as follows:

	Cubic yards.
From Western Branch Bar	14,932
From Sewall's Point Bar	221,883
Total	236,815

which, together with that removed under old contract, has been deposited on the west side of the river on the flats below Craney Island.

It was expected that the work at the Portsmouth Flats would have been completed during the fiscal year, but the Seaboard and Roanoke Railroad Company, to whom a portion of the adjacent property belongs, have been making great additions to their wharf property, which has caused that portion of the flats where the work is most needed to be occupied with pile drivers and dredges owned by private parties. Under these circumstances it would have been impossible for the contractor to have worked to advantage; this work has therefore been deferred.

The work at western branch bar was the cutting away of a lump, which was found below the cut previously made. The channel through this bar is now about 4,400 feet long and 265 feet wide, with a depth of not less than 25 feet at ordinary low-water.

Through Sewall's Point Bar one cut has been made about 14,000 feet long, and a second cut about two-thirds of this distance. These cuts are each 35 feet wide, and are also dredged to not less than 25 feet deep at mean low-water.

The work has been much delayed by bad weather, ice, accidents to the machinery, and the financial embarrassments of the contractors. Finding themselves unable to complete it in the required time, they asked for and were granted an extension of four months from June 30, under authority of the Chief of Engineers, dated June 21, 1881.

The river and harbor act approved March 3, 1881, appropriated $75,000 for continuing this improvement.

A project for the expenditure of this sum was submitted to the Chief of Engineers April 2 last. This project contemplates following the same general plan of improvement at first adopted, and having been approved by the Chief of Engineers, proposals have been invited for the dredging of 600,000 cubic yards of material, more or less; these will be opened July 29.

The greater portion of the dredging will be in widening the approaches to the harbor; a little is required at the Portsmouth Flats, and also in the South Branch for the special benefit of the United States navy-yard. Since the original estimate of the total cost of improving the harbor was made the increase in commerce has necessitated a large addition to the wharves of the city. A large part of the increase is on the eastern branch above the county bridge, where are situated the new wharves of the Norfolk and Western Railroad; this railroad has bought, and is about to remove, the county bridge, thus enlarging the area of the inner harbor. In order that the increased area may be made available, some dredging must be done in the eastern branch not originally contemplated. This, together with an increase beyond the depth originally proposed in some places, will necessitate appropriations beyond those originally asked for the thorough improvement of the harbor.

The work has been under the immediate supervision of Mr. George H. Elliott, assistant engineer.

The statistics of the port of Norfolk and Portsmouth furnished by the collector of customs, as also the cotton statistics furnished by the Norfolk Cotton Exchange, are hereto appended.

The appropriations for this work have been:

August 14, 1876	$35,000 00
June 18, 1878	50,000 00
March 3, 1879	75,000 00
June 14, 1880	50,000 00
March 3, 1881	75,000 00
	285,000 00

Money statement.

July 1, 1881, amount available	$64,460 24	
Amount appropriated by act approved March 3, 1881	75,000 00	
		$139,460 24
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	29,662 17	
July 1, 1881, outstanding liabilities	9,516 66	
		39,178 83
July 1, 1881, amount available		100,281 41
Amount (estimated) required for completion of existing project		93,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		93,000 00

Abstract of bids received for dredging at Norfolk Harbor, Virginia, and opened immediately after 12 m., September 4, 1880.

No.	Name and residence.	Time.		Number and kind of machines.	Daily amount of work expected.	Price.
		Commenced.	Completed.			
					Cu. yds.	*Cts.*
1	National Dredging Company, F. B. Colton general manager, Washington, D. C.	Nov. 1, 1880	June 30, 1881	....	....	10
2	Pardessus & Anthony, New York City.	Oct. 1, 1880	In six months	One clam shell	2,000	9½
3	Morris & Cumings Dredge Company, Joseph Cumings president, New York City.	As soon as awarded.	June 30, 1881	Two clam shells ...	....	12½
4	American Dredging Company, Isaac Albertson president, Philadelphia, Pa.	Dec. 1, 1880	June 30, 1881	One or more grapple dredges.	....	10
5	Geo. C. Fobes & Co., Baltimore, Md.	Oct. 1, 1880	June 30, 1881	One or more clam-shell dredges.	....	12$\frac{1}{16}$

COMMERCIAL STATISTICS.

Statement of the principal articles of produce shipped to foreign ports from Norfolk, Va., during the fiscal year ending June 30, 1881.

Cotton	bales..	325,012
Corn	bushels..	263,316
Staves		2,393,631
Live cattle	head..	920
Shingles		247,700
Treenails		47,420
Timber	feet..	48,792
Rosin	barrels..	500
Bark	bags..	250
Tobacco, in hogsheads	pounds..	69,563
Apples	barrels..	245
Railroad ties		12,500
Dogwood	cords..	194
Manganese	tons...	2,937
Collections on customs account		$35,013 42
Total value exports		$17,904,770 00

Entrances from foreign ports.

		Tonnage.
American vessels	11	9,048
Foreign vessels	69	84,843
Total	80	93,891

Clearances to foreign ports.

		Tonnage.
American vessels	24	19,581
Foreign vessels	97	114,775
Total	121	134,356

GEO. W. BLACK,
Deputy Collector.

CUSTOM-OFFICE,
Norfolk, Va., July 23, 1881.

LETTER OF SUPERINTENDENT AND SECRETARY OF THE NORFOLK AND PORTSMOUTH COTTON EXCHANGE.

NORFOLK AND PORTSMOUTH COTTON EXCHANGE,
Norfolk, Va., July 29, 1881.

DEAR SIR: Inclosed please find statement of cotton movement for twelve months ending June 30, 1881, as requested.

	Bales.
Total receipts	715,539
Exported direct	330,122
Shipped coastwise	375,444

EXPORTS.

	Quantity.	Value.
	Bales.	
Exported to Great Britain	317,350	$16,733,650
Exported to France	2,850	145,308
Exported to continent	9,922	508,624
	330,122	17,387,582

I remain, dear sir, yours, very truly,

NORMAN BELL,
Superintendent and Secretary.

Mr. GEO. H. ELLIOTT,
Assistant Engineer.

I 2.

IMPROVEMENT OF ARCHER'S HOPE RIVER, VIRGINIA.

The river and harbor act of March 3, 1879, directed an examination or survey of this river.

The survey was made in December, 1879, and a report on the same, accompanied by plans and estimates of cost of improvement, was submitted March 6, 1880, and will be found printed in the Report of the Chief of Engineers for that year, part 1, page 906.

The improvement proposed consists in dredging a channel 50 feet wide and 6 feet deep, where these dimensions are not found, between the mouth of the river, where it empties into James River, and the city of Williamsburg, between 4 and 5 miles above.

Two plans were submitted; the total cost of improvement under the first being estimated at $19,400.70; under the second, $13,571.58. Much of the work to be done was common to both plans. It was, however, recommended that operations be conducted under the first one, as the progress of the work would demonstrate the feasibility of the second one.

The act of March 3, 1881, appropriated $5,000 for this work. A project for the expenditure of this sum was submitted to the Chief of Engineers April 2, and by him approved. The project contemplates the dredging of channels as originally proposed, except that for the present they be not dredged to the full width, as the appropriation will do but a portion of the work.

The work will be done by contract, after due advertisement.

To complete the work proposed will require a further appropriation of—

Under first plan	$14,400 70
Under second plan	8,571 58

Archer's Hope River is in the collection district of Yorktown, Va.

The appropriation referred to herein is the only one that has been made for this work.

Money statement.

Amount appropriated by act approved March 3, 1881	$5,000 00
July 1, 1881, amount available	5,000 00
Amount (estimated) required for completion of existing project	14,400 70
Amount that can be profitably expended in fiscal year ending June 30, 1883.	14,400 70

I 3.

IMPROVEMENT OF PAGAN CREEK, VIRGINIA.

The act of Congress of June 14, 1880, appropriated $5,000 for this improvement.

A survey of the creek was made in 1874, under the direction of Mr. S. T. Abert, United States civil engineer.

Mr. Abert reported the obstructions to navigation to consist in four shoals between the mouth of the creek and the town of Smithfield, about 6 miles above. These bars are known as Bridge Bar, Wright's Bar, Bob Shoal, and bar at the mouth of creek.

He also states that some diking may be necessary.

A project for the expenditure of the appropriation of June 14, 1880, submitted August 26, 1880, contemplated the dredging of a channel not less than 60 feet wide and 8 feet deep at low-water through the three bars nearest Smithfield. This project having been approved by the Chief of Engineers, proposals were invited for the dredging of 18,000 cubic yards of material, more or less. The bids were opened October 22. The lowest bidder was Mr. H. E. Culpepper, at 16½ cents, with whom a contract was entered into for the execution of the work, which was to be completed June 30, 1881. The contractor was very much delayed during the winter by having his machinery frozen up at other points. The United States also had one of his dredges hired. These circumstances delayed the commencement of the work until May 30.

This delay made it impossible for the work to be completed by June 30, and the contractor asked for and was granted an extension of sixty days, or until August 31, under authority of the Chief of Engineers, dated June 21, 1881.

From May 30 to June 30, one cut was made, and a second cut partially made through Wright's Bar, one of the four obstructing bars. Six thousand six hundred and sixty-two cubic yards of material were removed, which have been deposited in the west side of James River, outside the creek. The river and harbor act approved March 3, 1881, appropriated $5,000 for this work. A project for its expenditure was submitted April 7. This project contemplated the continuance of operations in dredging through the obstructing bars as originally proposed, and having been approved by the Chief of Engineers, proposals have been invited for the removal of 18,000 cubic yards of material, more or less.

These proposals will be opened July 29, 1881. The work has been under the immediate supervision of Mr. George H. Elliott, assistant engineer.

Statistics of the commerce of the creek were expected. They will be forwarded as soon as received.

Pagan Creek is in the collection district of Norfolk, Va.

The appropriations for the work have been—

June 14, 1880	$5,000 00
March 3, 1881	5,000 00

Money statement.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$10,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	55 53	
July 1, 1881, outstanding liabilities	1,237 31	
		1,292 84
July 1, 1881, amount available		8,707 16
Amount (estimated) required for completion of existing project		18,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		18,000 00

Abstract of bids received for dredging in Pagan Creek, Virginia, and opened immediately after 12 m. October 22, 1880.

No.	Name.	Residence.	Time.		Number and kind of machines.	Price.
			Commenced.	Completed.		
1	H. E. Culpepper	Portsmouth, Va	Feb. 1, 1881.	June 30, 1881.	One dipper dredge.	$0 16½
2	G. H. Ferris	Baltimore, Md	Jan. 20, 1881.	July 1, 1881.		18

I 4.

IMPROVEMENT OF BLACKWATER RIVER, VIRGINIA.

The act of Congress of June 14, 1880, appropriated $3,500 for this work. A project for the expenditure of this sum was submitted June 24, in which it was proposed to continue the work of cutting off obstructing points at abrupt bends, which had been suspended May 22, 1880, owing to the near exhaustion of funds.

The last annual report gave a description of the work done up to June 30, 1880. This project was approved by the Chief of Engineers, but owing to the press of work in other localities and the impossibility of obtaining additional suitable machinery, operations were not commenced until January 20, 1881, when a dredge, which had previously been engaged at Coanjok Bay, was sent to Franklin (the present head of navigation proper on the Blackwater), and the cutting off of an obstructing point begun. This work was continued until February 25, when the point having been cut back some 74 feet, all that seemed to be needed, the dredge was moved to Littletown Point, 1½ miles below, where work of a similar character was begun and continued until April 6, when, the funds being nearly exhausted, the dredge was moved to the Scuppernong River. The point at Littletown, which was a very serious obstacle to navigation, the mail steamer frequently occupying half an hour in passing it, was cut back about 60 feet; some 12,000 cubic yards of material was removed at this point and was put back from 20 to 150 feet from the river bank. At the point at Franklin about 6,000 cubic yards was cut away, which was put back in a manner similar to that at Littletown.

At Franklin 90 linear feet of sheet-pile revetment was put up as a protection of the bank against further wash.

The cutting off of these points has been a material benefit to navigation, but it seems likely that the point at Littletown will require cutting back some 15 to 20 feet farther to fully obtain what is desirable.

The river and harbor act of March 3, 1881, appropriated $1,500 for this work.

The work remaining to be done is the cutting off of points which obstruct navigation.

A project for the expenditure of the recent appropriation was submitted April 7, in which it is proposed to continue this work.

The project has been approved by the Chief of Engineers, and the work will be prosecuted in accordance therewith.

The work has been under the immediate charge of Mr. George H. Elliott, assistant engineer.

Such certificates of the trade of the river as could be obtained are forwarded herewith.

The Blackwater River is in the collection district of Norfolk, Va.

The appropriations for the work have been:

June 18, 1878	$5,000 00
March 3, 1879	2,500 00
June 14, 1880	3,500 00
March 3, 1881	1,500 00

Money statement.

July 1, 1880, amount available	$3,731 26	
Amount appropriated by act approved March 3, 1881	1,500 00	
		$5,231 26
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880		3,740 90
July 1, 1881, amount available		1,490 36
Amount (estimated) required for completion of existing project		2,350 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		2,350 00

I 5.

IMPROVEMENT OF NOTTOWAY RIVER, VIRGINIA.

An examination and partial instrumental survey of this river was made during the months of November and December, 1878, having been directed in the river and harbor act of that year. The report upon same, acccompanied by a plan and estimate of cost of improvement proposed, was submitted January, 1879, and was printed in the Report of the Chief of Engineers for 1879, page 719.

The improvement proposed consists in the removal of all obstructions, natural and artificial, that now impede navigation, as high as "Peter's Bridge," a distance of about 50 miles above the mouth of the river. A small amount of cheap diking is proposed, to concentrate the water into a single channel at some points where chutes are found.

By means of these improvements it is expected that a depth of from 4 to 5 feet will be secured during about nine months of the year. The total estimated cost of the work was about $9,000.

The river and harbor act of June 14, 1880, appropriated $5,000 for this work. No work was done under this appropriation owing to the insufficiency of information with regard to bridges across the stream, of which there are four, which would require draws to be placed in them as the improvement progressed up stream to afford passage for the necessary machinery. It is believed that all difficulty with regard to these draws is now obviated.

The act of Congress of March 3, 1881, appropriated $2,000 for this work.

A project for the expenditure of this sum, as well as of the $5,000 previously appropriated, was submitted May 28 last. This project contemplates carrying out the original plan of improvement, and having been approved by the Chief of Engineers, operations in accordance therewith, will shortly be commenced.

The Nottoway River is in the collection district of Norfolk, Virginia.

The appropriations for this work have been:

June 14, 1880	$5,000 00
March 3, 1881	2,000 00
	7,000 00

Money statement.

July 1, 1880, amount available	$5,000 00	
Amount appropriated by act approved March 3, 1881	2,000 00	
		$7,000 00
July 1, 1881, amount available		7,000 00
Amount (estimated) required for completion of existing project		2,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		2,000 00

I 6.

IMPROVEMENT OF NORTH LANDING RIVER, VIRGINIA AND NORTH CAROLINA.

The act of Congress of June 14, 1880, appropriated $15,000 for continuing this work. A project for the expenditure of this sum was submitted on June 26 of that year. It was intended to carry out the general plan of improvement proposed, which was to dredge a channel 80 feet wide at bottom, and 9 feet deep at a low winter stage of water, where such a channel could not be found, to cut off several obstructing points at abrupt bends in the upper river, and to trim the banks of overhanging trees, remove logs, snags, &c. This project having been approved by the Chief of Engineers, proposals were invited for the removal by dredging of 110,000 cubic yards of material, more or less, to be opened September 4, 1880. The lowest bidder was Mr. G. H. Ferris, at 13.9 cents per cubic yard, with whom a contract was entered into, the work to commence October 15, 1880.

The dredging was commenced November 20, between beacons two and four, and continued until the 29th December, when operations were suspended owing to ice.

Work was resumed January 8, and continued until March 16, when the work was completed.

There were removed under this contract 64,354 cubic yards of material, which was deposited on the east and west sides of the river.

An examination of the work done under this contract was completed June 29, and it was found satisfactory.

The cutting off of obstructing points which was commenced May 28, 1880, was continued during July, at the lower point of double S bend, at the end of which month a part of the point had been cut back some 65 feet and a shoal immediately in front which extended some 50 feet out was dredged to 9 feet depth. About 5,000 cubic yards of material were taken up and moved from 100 to 150 feet back on the bank of the river. At this time the men employed were suffering to such an extent from malarial sickness that operations were for a time suspended.

They were resumed on February 24, 1881, at the same place and continued until April 3, when the dredge was withdrawn for repairs and the work suspended until May 6, when it was again resumed and continued at double S bend to June 9, when the dredge was moved to "Cypress Point," at which, and in the immediate vicinity, operations were continued to the close of the fiscal year. The work of cutting off obstructing points was done by the hire of machinery and labor in open market.

The work during the fiscal year has been the completion of a dredged channel 80 feet wide and 9 feet deep between beacons two and four, about 21,600 feet in length, under contract; the cutting back of the point at double S bend 115 feet and hauling back the material; the cutting back of "Cypress Point" 32 feet, and the dredging of 2 short shoals in the immediate vicinity. It is confidently believed that the navigation has been materially benefited by the work already accomplished, and that when the remainder of the obstructing points are trimmed and some short shoals dredged, all that is at present needed for this navigation will have been done.

The act of March 3, 1881, appropriated $7,500 for this work. A project for the expenditure of this sum was submitted April 2, which contemplated the continuance of the work of cutting off obstructing points, &c. This project has been approved by the Chief of Engineers, and operations will be carried out in accordance therewith.

This river is a link in the line of interior water communication south from Norfolk, Va., via the Albemarle and Chesapeake Canal.

The work has been in the immediate charge of Mr. George H. Elliott, assistant engineer.

This work is in the collection district of Norfolk, Va.

The statistics for this work, which also relate to Currituck Sound, are appended, having been furnished by the courteous president of the canal company, Hon. Marshall Parks.

The appropriations for this work have been:

March 3, 1879	$25,000 00
June 14, 1880	15,000 00
March 3, 1881	7,500 00
	47,500 00

Money statement.

July 1, 1880, amount available	$16,432 31	
Amount appropriated by act approved March 3, 1881	7,500 00	
		$23,932 31
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	13,275 53	
July 1, 1881, outstanding liabilities	3,406 10	
		16,681 63
July 1, 1880, amount available		7,250 68
Amount (estimated) required for completion of existing project		40,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		25,000 00

Abstract of bids received for dredging in North Landing River, Virginia and North Carolina, and opened immediately after 12 m., September 4, 1880.

No.	Name and residence.	Time.		Price.	Remarks.
		Commenced.	Completed.		
1	Geo. C. Fobes & Co., Baltimore, Md	....	....	$0 15	In accordance with specifications.
2	American Dredging Company, Isaac Albertson, president, Philadelphia, Pa.	Dec. 1, 1880	In 12 months.	18	
3	National Dredging Company, F. B. Colton, general manager, Washington, D. C.	Jan. 1, 1881	June 30, 1881	14	
4	G. H. Ferris, Baltimore, Md	Oct. 15, 1880	July 1, 1881	$13\frac{8}{10}$	
5	H. E. Culpepper, Portsmouth, Va	Oct. 15, 1880	June 30, 1881	$14\frac{1}{2}$	Not signed.

COMMERCIAL STATISTICS.

Number and class of vessels employed in navigating the southern branch of the Elizabeth River, North Landing River, Virginia; Currituck Sound, North River, and Albemarle and Pamplico Sounds, North Carolina, via the Albemarle and Chesapeake Canal, from July 1, 1880, to July 1, 1881.

Date.	Steamers.	Schooners.	Sloops.	Barges.	Lighters.	Boats.	Rafts.	Total.
1880.								
July	275	267	101	37	55	211	20	966
August	250	135	27	27	35	45	23	540
September	266	85	14	34	25	10	14	448
October	301	96	32	42	28	14	16	529
November	282	109	22	51	29	14	17	524
December	272	116	27	51	42	7	11	526
1881.								
January	232	124	30	43	48	6	11	492
February	208	130	52	29	30	5	10	466
March	316	193	37	65	30	25	19	685
April	322	175	38	53	31	15	19	653
May	326	193	38	63	26	15	32	693
June	320	124	18	51	20	9	33	575
	3,370	1,747	436	546	399	376	225	7,097
North	1,720	870	220	276	200	191	225	3,694
South	1,650	877	216	270	199	185	....	3,403
Total	3,370	1,747	436	546	399	376	225	7,097

Statement of inward receipts of leading items of produce, transported from points on the Pamplico, Croatan, Albemarle, Core, and Currituck Sounds, of North Carolina, embracing all of the leading rivers, via the Albemarle and Chesapeake Canal, from 1st July, 1880, to 1st July, 1881.

Date.	Cotton.	Fish.	Naval stores.	Spirits of turpentine.	Rags.	Old junk and iron.	Eggs.	Bacon.
1880.	*Bales.*	*Barrels.*	*Barrels.*	*Casks.*	*Pounds.*	*Pounds.*	*Dozens.*	*Pounds.*
July	411	....	1,358	158	86,250	14,660	7,811	4,340
August	463	7	1,848	149	10,820	22,000	5,060	2,860
September	8,751	8	1,823	162	13,540	51,280	8,427	6,156
October	22,527	213	1,624	287	17,710	29,470	8,685	8,988
November	19,943	616	1,109	135	23,554	22,754	6,364	17,260
December	25,580	308	1,840	84	9,140	21,000	8,727	16,520
1881.								
January	9,004	126	1,791	141	19,970	25,930	8,570	3,230
February	8,649	236	1,825	290	18,130	9,370	8,455	3,300
March	5,594	446	2,422	160	14,950	10,580	14,722	26.470
April	1,950	650	1,686	55	16,170	34,540	12,873	11,670
May	689	4,581	2,577	132	15,550	18,710	10,509	11,700
June	649	575	1,801	133	21,250	20,400	8,685	6,715
Total	104,210	7,766	21,699	1,886	214,534	280,694	108,388	119,150

Date.	Pine and oak wood.	Corn.	Pease and beans.	Railroad ties.	Potatoes.	Juniper logs.	Peanuts.	Rough rice.
1880.	*Cords.*	*Bushels.*	*Bushels.*		*Bushels.*	*Cords.*	*Bushels.*	*Bushels.*
July	271	8,871	250	9,120	3,935	572	2,578	....
August	135	10,574	....	8,367	897	485	4,851	....
September	119	4,803	579	8,875	4,470	693	2,340	....
October	163	2,925	1,592	7,718	5,060	250	1,694	3,565
November	120	5,264	575	3,981	3,440	321	1,417	9,630
December	627	21,048	1,059	6,027	2,437	....	13,327	11,000
1881.								
January	276	52,253	735	13,569	423	297	6.165	1,294
February	176	88,425	562	4,007	946	238	11,963	2,036
March	199	106,886	476	18,535	5,554	166	3,620	1,562
April	43	113.232	633	11,287	2,908	151	3,398	460
May	102	56,943	298	13,340	5,045	171	924	....
June	1	10,819	412	15,150	21,577	445	1,162	....
Total	2,232	482,043	7,171	119,476	56,694	3,769	53,439	26,547

Date.	Wheat.	Lumber, B. M.	Shingles, sap and heart.	Staves.	Articles, unenumerated.	Passengers.
1880.	*Bushels.*	*Feet.*			*Tons.*	
July	5,172	5,728.789	2,212.400	11,900	5,700	254
August	....	6,465,018	2,918,450	400	7,210	233
September	1,464	4,367,071	2,247,084	6,600	10,970	220
October	2,029	4,052.466	1,705,400	5,100	9,810	168
November	30	3,772.164	1,234,950	490	12,792	170
December	142	1,960,103	1,095,200	31,000	10,110	257
1881.						
January	7,625	2,684,474	797,150	800	7,192	192
February	73	2,615.569	809,200	38,000	2,919	174
March	307	4,929,866	1,695,900	5,900	20,180	242
April	25	6,093,867	2,394,900	10,200	16,120	200
May	....	9,194,399	3,248,250	13,350	12.716	259
June	....	8,848,600	2,514,850	10,341	19,160	160
Total	16,867	60,712.381	22,873,734	134,081	134,879	2,529

I 7.

IMPROVEMENT OF CURRITUCK SOUND, COANJOK BAY, NORTH RIVER AND BAR, NORTH CAROLINA.

This work, which is a connecting link in a line of contemplated inland navigation to the South, via the Albemarle and Chesapeake Canal, was commenced under an appropriation of $20,000 made by act approved June 18, 1878. The plan of improvement adopted was the dredging of a channel 80 feet in width at bottom and 9 feet deep at an ordinary winter stage of water through the entire length of the upper sound, about 10½ miles.

The river and harbor act of March 3, 1879, appropriated $25,000 for continuing this work. Under this last appropriation a contract was entered into with Mr. G. H. Ferris for the removal of 200,000 cubic yards of material, more or less, the work to be completed by September 30, 1880.

As stated in the Annual Report for 1880, to which, as well as that of 1879, reference is requested for details of previous operations, it would have been desirable that the work should be completed during the fiscal year, but the difference between the bid of Mr. Ferris and the next lowest was so material that it was considered to justify the delay. Dredging was continued during July and August, 1880, in the cuts between beacon, 6 and 7 and 7 and 8. During the latter month, Mr. Ferris, finding that he would be unable to complete his contract within the specified times requested an extension, which was granted by authority of the Chief of Engineers, dated August 30, 1880. Work was continued under the extension to October 31, when Mr. Ferris was allowed to stop work, a contract at a lower price having been previously made. From June 30 to October 31, there were removed under the contract with Mr. Ferris—

	Cubic yards.
From between beacons 6 and 7	5,981
From between beacons 7 and 8	70,485
Total	76,466

The act of Congress approved June 14, 1880, appropriated $25,000 for continuing the improvement of Currituck Sound, Coanjok Bay, and North River Bar, North Carolina. As Coanjok Bay had not formed a part of the original work, a survey was made and estimate of cost of improvement of this portion of the work submitted to the Chief of Engineers December 28, 1880, and was printed in House Ex. Doc. No. 28, Forty-sixth Congress, third session, to which reference is requested.

A project for the expenditure of the appropriation of June 14, 1880, was submitted to the Chief of Engineers June 25, and having been approved, proposals were invited for the removal by dredging of 150,000 cubic yards of material, more or less.

These proposals were opened September 4; the lowest bidders were the National Dredging Company, at 14 cents per cubic yard, with whom a contract was entered into, the work to be commenced December 1.

Under authority of the Chief of Engineers, dated October 14, 1880, dredging was commenced in Coanjok Bay by the hire of a dredge and hoister in open market. This work was continued until January 18, 1881, when, a cut having been made through the bay, all the work at present contemplated, the dredge was withdrawn. The amount of material removed from this locality is estimated at 13,500 cubic yards.

On December 9, 1880, dredging was commenced by the National Dredging Company, under their contract, in the cut between beacons 7 and 8, with one clam-shell dredge. It was soon found that it would not do the work at that place, and was moved to the channel between beacons 5 and 6, on the 16th, where the work was continued until the 29th, when, owing to ice, operations were suspended, and not resumed until January 24, 1881, when a dipper dredge was put in cut between beacons 7 and 8, and on the 25th another dredge between 5 and 6.

The work was continued with these two dredges until March 24, when the dredge between beacons 7 and 8 was withdrawn; the other dredge worked until May 30 between beacons 5 and 6, since that time between 7 and 8.

The whole amount of material removed under this contract is—

	Cubic yards
From between beacons 5 and 6	89,692
From between beacons 7 and 8	22,465
Total	112,157

which, together with that removed under previous contract, has been deposited on the east and west sides of the sound.

The work accomplished during the fiscal year has been the cutting of a channel about 52 feet wide between beacons 5 and 6, the completion of a channel about 50 feet wide between beacons 6 and 7, a channel from 25 to 100 feet wide between beacons 7 and 8, and a channel about 25 feet wide through Coanjok Bay; all these channels excavated to a depth of 9 feet at ordinary winter water.

A sketch herewith shows the relative positions of the beacons referred to.

The river and harbor act of March 3, 1881, appropriated $30,000 for Currituck Sound, Coanjok Bay, North River and Bar, North Carolina. This brings North River, not previously included, within the scope of the appropriation, and, as no estimate for the improvement of this river has been submitted in connection with this work, when opportunity offers an examination will be made, and estimate of cost of improvement submitted. It is not considered desirable, however, to commence any improvement of the river or bar until the channels through Currituck Sound and Coanjok Bay are completed.

A project for the expenditure of the recent appropriation was submitted to the Chief of Engineers April 2 last.

It is proposed to continue the general plan of improvement through the sound, to widen a portion of the channel through Coanjok Bay, and to construct a dike of oyster shells on the west side of this bay for about 9,200 feet. This project having been approved by the Chief of Engineers, proposals have been invited for the dredging of 90,000 cubic yards of material, more or less, and the delivery in place of about 312,000 bushels of oyster shells.

The work has been under the immediate supervision of Mr. George H. Elliott, assistant engineer.

This work lies in the collection district of Norfolk, Va.

For commercial statistics reference is requested to the report on North Landing River, as the commerce of each is nearly the same.

The appropriations for this work have been—

June 18, 1878	$20,000 00
March 3, 1879	25,000 00
June 14, 1880	25,000 00
March 3, 1881	30,000 00
	100,000 00

Money statement.

July 1, 1880, amount available	$40,852 22	
Amount appropriated by act approved March 3, 1881	30,000 00	
		$70,852 22
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	29,120 63	
July 1, 1881, outstanding liabilities	6,430 78	
		35,551 41
July 1, 1881, amount available		35,300 81
Amount (estimated) required for completion of existing project		40,213 95
Amount that can be profitably expended in fiscal year ending June 30, 1883.		40,213 95

Abstract of bids received for dredging in Currituck Sound, North Carolina, and opened immediately after 12 *m. September* 4, 1880.

No.	Name.	Residence.	Time.		Price.
			Commenced.	Completed.	
1	National Dredging Company, F. B. Colton, general manager.	Washington, D. C.....	Dec. 1, 1880	June 30, 1881	$0 14
2	G. H. Ferris..................	Baltimore, Md.........	Nov. 15, 1880	July 1, 1881	17½
3	American Dredging Company, Isaac Albertson, president.	Philadelphia, Pa.......	Dec. 1, 1880	In 12 months	22

SURVEY OF COANJOK BAY.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., December 28, 1880.

GENERAL: In my last annual report upon the "Improvement of Currituck Sound and North River Bar, North Carolina," I had the honor to state as follows: "As Coanjok Bay has been added to this work, a survey and estimate of cost of improving same will be made in time to decide whether it will be better to apply the balance to improving the bay or the bar at the mouth of North River."

In my report the context indicated that this balance referred to the surplus of the present appropriation after completing the improvement of Currituck Sound.

During the present month, my assistant, Mr. George H. Elliott, has completed a survey of that portion of Coanjok Bay which it is proposed to improve, and I have the honor to transmit herewith a tracing, showing the location and dimensions of the proposed channel and its protecting dike.

Coanjok Bay, like Currituck Sound, is a link in the line of water communication between Norfolk Harbor and Albemarle Sound, the line being known as the Albemarle and Chesapeake Canal route.

It is proposed to excavate a channel through the bay of the same dimensions as those now being given to the channel through Currituck Sound, viz, 80 feet in width at bottom and 9 feet in depth at an ordinary *winter* stage of water. The cut will be 14,226 feet in length, and will require the excavation of material as follows: In bank, 31,871 cubic yards; in cut, 144,754 cubic yards; total, 176,625 cubic yards, which, at 20 cents per yard, will amount to $35,325.

This cut will need to be protected on the western side over the greater portion of its length. It is proposed to accomplish this by means of a dike, which, in this locality, can be most cheaply constructed of oyster shells.

The proposed dike will be 9,200 feet in length, will be located 25 feet away from the cut, and will be of the following dimensions: width at bottom, 10 feet; width at top, 4 feet; height, 6 feet.

A dike of the above dimensions will require 34 bushels of shells to each linear foot. Total for 9,200 linear feet, 312,800 bushels.

These shells can be put in place for 3½ cents per bushel. The total cost of dike, $10,948, or at the rate of $1.19 per linear foot.

RECAPITULATION.

Dredging 176,625 cubic yards, at 20 cents	$35,325 00
9,200 linear feet dike, at $1.19 per foot	10,948 00
Add 15 per cent. contingencies, superintendence, &c	6,940 95
Total	53,213 95
From which deduct (being the approximate amount which will be expended in the bay under existing authority from the Chief of Engineers)	3,000 00
Balance	50,213 95

The expenditure of the above amount appears to me to be proper to be made for the improvement of Coanjok Bay.

It can well be expended to good advantage during a single fiscal year, and I respectfully recommend that the amount be added to the $20,000 asked for in the last annual report for the "improvement of Currituck Sound, Coanjok Bay, and North River Bar, North Carolina."

I am, general, very respectfully, your obedient servant,

CHAS. B. PHILLIPS,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

I 8.

IMPROVEMENT OF SCUPPERNONG RIVER, NORTH CAROLINA.

Work during the fiscal year has been carried on under the balance of an appropriation of March 3, 1879, and the appropriation of June 14, 1880.

A project for the expenditure of the latter appropriation was submitted June 24, 1880, and contemplated carrying out the original plan of improvement, or such portion of it as remained to be done, which was, since the excavation of a channel through the bar at the mouth, and the trimming of the banks, and the removal of snags and logs, to cut off some obstructing points.

The project was approved by the Chief of Engineers, and operations commenced April 6, 1881, at what is known as the "Thoroughfare," which is really a cut-off; this, which was very narrow, barely admitting a propeller steamer which goes up the river, was widened some 23 feet, and now affords a free passage for the largest vessel on the river.

After making this cut, another one was made at what is known as the "Devil's Elbow," a very abrupt bend. Some 1,800 cubic yards of material were removed. Owing to the near exhaustion of funds the work was suspended May 4.

The material encountered was a mass of roots and stumps, and required the use of 60 pounds of dynamite to put it in such condition that the dredge could remove it.

The act of Congress of March 3, 1881, appropriated $1,000 for this work.

A project for the expenditure of this sum was submitted April 7, in which it is proposed to continue the cutting off of obstructing points, as originally contemplated. This project has been approved by the Chief of Engineers, and in accordance therewith operations will be carried out.

The work has been under the immediate supervision of Mr. George H. Elliott, assistant engineer.

Scuppernong River is in the collection district of Albemarle, N. C.

Partial statistics of the work are expected and will be forwarded as soon as received.

The appropriations for the work have been:

June 18, 1878	$2,000 00
March 3, 1879	2,000 00
June 14, 1880	1,000 00
March 3, 1881	1,000 00
	6,000 00

Money statement.

July 1, 1880, amount available	$1,576 26	
Amount appropriated by act approved March 3, 1881	1,000 00	
		$2,576 26
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	1,149 06	
July 1, 1881, outstanding liabilities	168 75	
		1,317 81
July 1, 1881, amount available		1,258 45
Amount (estimated) required for completion of existing project		2,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		2,000 00

I 9.

IMPROVEMENT OF PAMPLICO AND TAR RIVERS, NORTH CAROLINA.

The act of June 14, 1880, appropriated $9,000 for this work, and operations during the past fiscal year have been carried on in accordance with approved project for the expenditure of the same.

The work accomplished has been (on the Pamplico) the widening of the channel previously dredged, about 1¼ miles below Washington, by the removal of stumps, large and small.

This work was commenced early in August last; suspended in September to enable work to be done on the Tar, while the stage of water was favorable for operations there. It was recommenced in March, and has been continued up to the close of the year, except about three weeks during May, when it was suspended to enable some additions to be made to the working plant, the hand-power hoister formerly in use being changed to a steam hoister with dredging appliances.

There have been removed from the vicinity of the dredged channel referred to, 1,197 stumps, 239 of which were blasted, and 2,235 cubic yards of mud, sand and roots have been removed from the same locality.

On the Tar River the work accomplished has been the construction of jetties, of which twenty two, aggregating 3,233 linear feet in length, were built at various shoals between "Sparta," 9 miles below Tarborough, and "Taft's Landing," 28 miles below Tarborough. These jetties are all built of two rows of piles 3 feet apart, the piles 5 feet apart; the space between the rows is filed with brush and packed solid; the lines of piles are wattled with small limbs and brush.

In addition to the work on jetties, 434 logs, 2,489 snags, and 165 stumps have been taken out of the river; of the latter ten required blasting to remove them. Three thousand six hundred and seventy-two overhanging trees were also removed from the banks of the river.

For further details of the operations, commercial statistics, &c., reference is made to the report of Mr. John P. Darling, assistant engineer in immediate charge of the work.

The river and harbor act of March 3, 1881, appropriated **$8,000** for this work. A project for the expenditure of this sum, submitted April 2, contemplates dividing the amount equally between the two rivers and continuing the work of widening and straightening the dredged channel below Washington by dredging, and the removal of stumps, roots, &c.

In the Tar, the construction of additional jetties, and the repair of some which have been damaged, and the removal of logs and snags which have been brought down the river by the freshet water.

The project has been approved, and the work will be conducted in conformity therewith by hired machinery and labor.

The work on these rivers having exceeded in amount that originally estimated for, if it is considered desirable to continue the improvements, new examinations and estimates are necessary.

The appropriations for the work have been:

June 14, 1880	$9,000 00
March 3, 1881	8,000 00

Money statement.

July 1, 1880, amount available	$9,255 61	
Amount appropriated by act approved March 3, 1881	8,000 00	
		$17,255 61
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	6,987 10	
July 1, 1881, outstanding liabilities	1,405 14	
		8,392 24
July 1, 1881, amount available		8,863 37
Amount that can be profitably expended in fiscal year ending June 30, 1883		15,000 00

REPORT OF MR. JOHN P. DARLING, ASSISTANT ENGINEER.

WASHINGTON, N. C., *June* 30, 1881.

CAPTAIN: I have the honor to make the following report on the improvements of the Pamplico and Tar rivers, North Carolina, under act of Congress of June 14, 1880, appropriating $9,000 for that purpose. The project for expending the money contemplated using $3,500 in removing stumps from and widening the dredged channel of the Pamplico River 1¼ miles below Washington between points A and C (see map accompanying annual report of June 30, 1880). The balance of the appropriation, $5,500, to be expended on the Tar River in putting in cheap jetties between Taft's Landing and Tarborough, a distance of 35 miles; also in cutting and removing from the banks over hanging trees, and in taking out logs and snags from the river between the points named.

The work was done by hired labor and machinery, and the material bought in open market. The work was commenced on the Pamplico about the 2d of August, in widening the dredged channel 1¼ miles below Washington, by pulling the stumps found in it. This work was continued until some time in September, when it was stopped to commence work on the Tar River. The work was recommenced on the Pamplico in March and continued up to the present time, with the exception of about three weeks in May, to allow Captain Bowdoin to put engines in his hoister and rig her also for dredging; he commenced dredging on the 19th of May. During the year there have been 1,197 stumps removed (239 of which have been blasted), and 2,235 cubic yards of mud, sand, and roots taken out of the channel of the Pamplico River. The dredging is very slow work on account of the many small stumps and roots left after removing the large ones.

COMMERCIAL STATISTICS—EXPORTS.

Bales cotton	27,875
Barrels naval stores	10,469
Bags pease	115
Barrels wax	42
Bags rice	4,960
Feet lumber	3,490,975
Shingles	1,030,000
Staves	42,900
Miscellaneous barrels	1,963
Boxes and crates	1,619
Bales	115

These items were shipped coastwise and foreign from Washington, N. C.

Work was commenced on the Tar River in September, during which month a pile-driver and scows were built for the contemplated improvements, consisting of building jetties and removing logs and snags.

This work continued until some time in March.

Twenty-two jetties were put in on some of the worst shoals between Taft's Landing, 7 miles below Greenville and Sparta, 19 miles above Greenville and 9 miles below Tarborough, namely:

Three jetties at Tripp's Shoal, 3¼ miles below Greenville; one at Foley's Cross, 2¾ miles below; two at Red Bank, 2 miles below; one at Sycamore Cross, 1¾ miles below; one one-third mile below; two at Greenville; one just below cut-off; one at Tabor's Landing, 4 miles above Greenville; three just above Harrington's Mill, 6 miles above Greenville; one at Blue Bank, 7 miles above; three near Peeble's Landing, 18 miles below Tarborough; one near Dupree's Landing, 15 miles below Tarborough. These jetties are built of two rows of piles, the rows 3 feet apart and the piles 5 feet apart; the space between the rows filled with brush and solidly packed; the sides are interwoven with small limbs and brush. The whole number of feet of jetties that have been built is 3,233.

There were 434 logs, 2,489 snags, 165 stumps (ten of which were blasted) removed from the river, also 3,672 overhanging trees cut and removed from the banks. I find on examination that there are still a number of shoals between Greenville and Tarborough that require jetties, besides repairing the damages to those already in. There are also a large number of logs and snags to be taken out, which were brought down by the last freshet.

It is proposed to expend the $8,000 appropriated for the present year by dividing the amount above equally between the Pamplico and Tar rivers, in continuing the work of widening and straightening the dredged channel 1¼ miles below Washington and in repairing damaged jetties on the Tar, and in putting in additional ones between Taft's Landing and Tarborough; also in taking out the logs, stumps, and snags deposited in the channel by last winter freshets; cutting and removing from the banks a large number of overhanging trees that would eventually fall into the river, and in putting in a few bank protectors at exposed points, if the money holds out.

There are at present three steamers running between Washington and Tarborough and another is being built; they can run to Tarborough only about eight months in the year; the rest of the time they only run to Greenville.

The Pamplico and Tar Rivers are in the collection district of New Berne, N. C.

Very respectfully, your obedient servant,

JOHN P. DARLING,
Assistant Engineer.

Capt. JAMES MERCUR,
Corps of Engineers, U. S. A.

I 10.

IMPROVEMENT OF THE NEUSE RIVER, NORTH CAROLINA, FROM ITS MOUTH TO THE HEAD OF NAVIGATION.

Work during the fiscal year has been conducted in accordance with approved project for the expenditure of the appropriation ($45,000) made by act of Congress approved June 14, 1880.

Under previous appropriations the work of improvement did not extend above the Wilmington and Weldon Railroad Bridge, near Goldsborough, but the present one continued it to the head of navigation, Smithfield, 62 miles above. Operations have therefore been conducted both above and below the bridge.

Above the bridge the work has consisted in the removal from the bed of the river of all obstructions, snags and logs, and the trimming of the banks of all overhanging trees; this work has been carried about 12 miles towards Smithfield.

Below the bridge the work has consisted in the construction of log and brush jetties to contract the water-way; of these about 5,000 linear feet were built between Pitch Kettle and Deer Neck, points about 10 miles apart. Two pile and log dams about 600 feet long were built to prevent the flow of water from Neuse River into Grindle Creek. A very crooked and difficult bend at Bull Point has been revetted with logs and guarded by bank protectors to prevent caving.

The heavy and continued freshets of the winter showed that the log and brush jetties were scarcely of sufficient stability to continually resist the action of the current. All that have been built since the winter freshets have been constructed of lumber, consisting of square piling with cap pieces firmly bolted to the piles, and sheet piling, also well driven and spiked to the cap pieces.

The ends of these jetties are also protected by log and brush mattresses weighted with stone.

For the details of the operations, commercial statistics, &c, reference is requested to the report of Mr. R. Ransom, assistant engineer, in immediate charge of the work.

The survey of this river, made in 1871, was conducted under unfavorable circumstances, flush-water prevailing for a considerable portion of the time.

It was thus impossible to arrive accurately at the amount of work which would be required to clear out the bed of the river. Mr. Ransom estimates that from $30,000 to $40,000 more will be required to thoroughly complete the improvement than was originally estimated.

The river and harbor act of March 3, 1881, appropriated $30,000 for continuing this work. A project for the expenditure of this sum was submitted April 8, which contemplates the continuance of the work of clearing the river bed and trimming the banks, together with the construction of about 1,500 linear feet of wattle-dam, 200 linear feet of dike, and perhaps some dredging in the river above the Wilmington and Weldon Railroad Bridge, near Goldsborough, and the construction of jetties with some dredging near the mouth of Contentnea Creek, in the river below the railroad bridge.

This project has been approved by the Chief of Engineers, and the work will be conducted in accordance therewith.

On account of the nature of the work, it being so diversified in character as not to admit of exact specification, it will be carried on by the hire of machinery and labor and the purchase of material in open market.

The appropriations for the work have been:

June 18, 1878	$40,000 00
March 3, 1879	45,000 00
June 14, 1880	45,000 00
March 3, 1881	30,000 00

Money statement.

July 1, 1880, amount available	$63,245 10	
Amount appropriated by act approved March 3, 1881	30,000 00	
		$93,245 10
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	30,387 57	
July 1, 1881, outstanding liabilities	7,991 58	
		38,379 15
July 1, 1881, amount available		54,865 95
Amount (estimated) required for completion of existing project		13,761 84
Amount that can be profitably expended in fiscal year ending June 30, 1883.		50,000 00

REPORT OF MR. R. RANSOM, ASSISTANT ENGINEER.

NEW BERNE, N. C., *June* 30, 1880.

CAPTAIN: I have the honor to submit the following report of work upon Neuse River, North Carolina, during the past year.

At the date of my last annual report the force employed upon the river was at a point 3 miles above Pitch Kettle, 24 miles above here, clearing out obstructions. That portion of the river had been very hastily and imperfectly gone over, as is explained in my previous reports. Clearing out was continued up to Kinston early in October, thus completing this character of work up to the Wilmington and Weldon Railroad near Goldsborough, a distance of 105 miles from the point lowest down the river at which such work was done.

In October two pile drivers were built and put upon the steam hoisters, to be used in building jetties; and the main force with all machinery was sent to join a small party that I had been working upon *log* and *brush* jetties above Village Creek. The action of this kind of jetty was so effective and satisfactory that it was determined to place them on all shoals between Pitch Kettle and Kinston. Forty-three of these jetties, aggregating about 5,000 linear feet, were put in between Pitch Kettle and Deer Neck, a distance of about 10 miles. Two pile and log dams, to prevent the flow of water from Neuse River into Grindle Creek, about 600 feet long, were constructed before the end of November, and that crooked and difficult bend at Bull Point was thoroughly revetted with logs and guarded by bank protectors by the expiration of that month.

The river having fallen again, jettying was recommenced, but a sudden rise soon put a stop to that work, and found several jetties unfinished.

This rise continued through the entire winter. The very high-water and the Christmas holidays put an end to work from December 24 to January 8.

The water continuing very high, one hoister was dispatched with an adequate accompanying force, to proceed above the Wilmington and Weldon Railroad to clear the river from there towards Smithfield, in Johnston County.

Nearly a month was consumed in covering the 50 miles above Kinston, as no tug could be hired, and the machine had to draw itself against a strong current at flood-tide. That machine and force have been clearing the channel and banks since the end of January, and have very thoroughly done the work for something near 12 miles above the railroad, and that work is still progressing.

The other larger force was put to work at the most troublesome point on the river between New Berne and Kinston, Southwest Bends, where the channel is very crooked, the current always strong, and the banks continually caving. Here very heavy work for nearly a mile was done in revetting the banks and in endeavoring to improve and fix the channel. It is believed that this will be accomplished. A cut-off would have been made here but for stone underlying the proposed line of the cut. Until the middle of May this larger force was employed in building bank protectors and in some minor work between the Atlantic and North Carolina Railroad and Bull Point, when jettying was resumed. The heavy and continued freshets of winter had demonstrated that the log and brush jetties would hardly resist the force of violent currents, and we have built since the middle of May 3,230 linear feet of lumber jetties, piles 8 inches by 8 inches, cap-sills 4 inches by 6 inches, sheeting 2 inches by 8 inches, all heart pine firmly driven.

The cap-sills are fastened to the piles by wrought-iron bolts and the sheeting is nailed to the cap-sills with large cut nails. The ends of the jetties next the current are well protected by log and brush mattresses, sunken and filled to above low-water with stone. It is proposed to put these jetties upon all shoals between Pitch Kettle and Kinston. Approximately it will require about 15,000 feet more.

Finish these jetties; complete the channel on the east front of New Berne by widening, deepening, and extending it; and carry the work of clearing out up to Smithfield, and all will have been done which is at present demanded upon this stream.

With a small addition to the amount estimated by the engineers, the improvement made will far exceed what was contemplated. When the work shall be completed there will be a channel the *year around* at *very lowest stage* of water, where boats drawing not more than 3 feet can pass from New Berne to Kinston; from Kinston to the Wilmington and Weldon Railroad the same boats will be able to run for two-thirds of the year, and the same may pass for six months up to Smithfield, while craft of less draught can easily go for a much longer period of the year.

There have been made four appropriations for this work; $40,000, $45,000, $45,000, and $30,000. In my judgment it will require about $30,000 to $40,000 more to finish, as it should be done, the projected work. This would carry the sum of the appropriations to $190,000 or $200,000; that is, $15,000 or $25,000 more than estimated for by the first and only survey made. When the large extent of the work, the number of years necessarily required to do it, the various difficulties met and overcome, and the great benefits accruing and to be realized are properly considered, a much greater outlay might well and reasonably have been expected to be made.

The opening of Contentnea Creek or River, the main tributary to the Neuse, will very greatly increase the trade to this port and largely benefit the agricultural and commercial interests of an extensive region.

All the work has been done by hired labor and some hired machinery, any other method being impracticable from the nature of the improvements, and of the stream itself. It is proposed to continue the same kind of labor until the improvements shall be completed.

Below are appended commercial statistics of this port, pertaining in a great measure to this river.

EXTRACT FROM REPORT OF BOARD OF TRADE OF NEW BERNE, N. C., MAY 31, 1881, SHOWING AMOUNT OF PRODUCE SHIPPED DURING THE PREVIOUS TWELVE MONTHS.

Rice	bushels..	67,440
Rice	tierces..	200
Corn	bushels..	436,368
Cotton	bales..	34,500
Plates	wooden..	8,000,000
Fresh fish	pounds..	1,152,000
Salt	barrels..	3,000
Lumber	feet..	9,150,000
Shingles		9,000,000
Pine straw	pounds..	1,125,000
Oysters	bushels..	60,000
Cotton yarn	pounds..	140,000
Naval stores	barrels..	6,098
Truck (beans, pease, potatoes, &c.)	bushels..	90,000

"The immense increase in receipts of this port of all kinds of produce being largely due to the increased facilities of our river transportation."

The collector of the port reports:

	Number of vessels.	Tons.
Vessels entered from foreign ports	14	1,449.43
Vessels cleared for foreign ports	16	1,652.19
Vessels entered coastwise	213	85,978.00
Vessels cleared coastwise	7	968.00

Value of dutiable imports	$9,524 00
Amount of duty collected	2,649 71
Value of fur goods	2,828 64
Domestic exports	20,238 00

This report does not refer to internal commerce.

The above reports are most encouraging as compared with similar ones of three years ago. They exhibit a healthful and vigorous progress, giving the best earnest of a substantial, rapid, and lasting prosperity among the people of this region.

This work lies in the second collection district of the State, the office being at New Berne, N. C.

I am, sir, very respectfully, your obedient servant,

R. RANSOM,
Assistant Engineer.

Capt. JAMES MERCUR,
Corps of Engineers, U. S. A.

I 11.

IMPROVEMENT OF TRENT RIVER, NORTH CAROLINA.

The act of Congress approved June 14, 1880, appropriated $10,000 for continuing this improvement.

Work during the last fiscal year has been conducted in conformity to approved project for the expenditure of this sum.

The clearing out of logs and stumps and the trimming of the banks of overhanging growth was commenced in August at the mouth of the river and continued up to Quaker Bridge, a distance of 29 miles, where it connected with work of this character done the previous year. This work was discontinued in November last.

The dredging through obstructing bars, which it was expected would be commenced in November, was, owing to bad weather (which prevented the dredge hired for the work from getting to the scene of operations), not begun until February 10, last.

Since that time about 25,000 cubic yards of material have been taken out, consisting of sand, mud, marl, and shell rock; some of the latter required blasting.

On account of the distance to which it was necessary to move the dredged material, a tug-boat was hired and has been in use in connection with the dredge up to the close of the fiscal year.

For details of the operations, commercial statistics, &c., reference is requested to the report of Mr. R. Ransom, assistant engineer in immediate charge, forwarded herewith.

A survey of this river was made in 1878.

The estimated cost of proposed improvements at that time was $22,000.

As the water was from 3½ to 6 feet above a low stage, many snags which obstructed navigation were not encountered. During the progress of the work they have been removed.

In spite of the most rigid economy, however, it has been impossible to keep the cost of the whole improvement within the limits of the estimate, and as it is quite important that the improvement should be completed, an additional amount will be asked for in the future for this purpose.

The river and harbor act of March 3, 1881, appropriated $5,000 for this work.

A project for the expenditure of this amount was submitted April 8, in which it was proposed to continue operations in accordance with the original plan, first of all completing the dredging required, and afterwards resuming the taking out of snags and logs and the trimming of the banks.

The appropriations for the work have been:

March 3, 1879	$7,000 00
June 14, 1880	10,000 00
March 3, 1881	5,000 00

Money statement.

July 1, 1880, amount available	$10,128 37	
Amount appropriated by act approved March 3, 1881	5,000 00	
		$15,128 37
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	6,977 13	
July 1, 1881, outstanding liabilities	3,302 67	
		10,279 80
July 1, 1881, amount available		4,848 57
Amount that can be profitably expended in fiscal year ending June 30, 1883		12,000 00

REPORT OF MR. R. RANSOM, ASSISTANT ENGINEER.

NEW BERNE, N. C., *June* 30, 1881.

CAPTAIN: I have the honor to submit the following statement of operations for the improvement of Trent River, North Carolina, since the date of my last annual report:

In August last, work was resumed and devoted to clearing the river of obstructions, such as logs, stumps, and overhanging growth, which operation continued to the end of November. The work was begun in August at the mouth of the river, and progressed up stream to join what had been done above Quaker Bridge the previous year. The logs and stumps were very thoroughly removed, but between Pollocksville and Quaker Bridge, and a little way above the bridge, the overhanging growth has not been as clearly cut as necessary. This omission was intentional, as it was desired to remove the bars and shoals above the bridge, and it was known that the appropriation would not suffice for both purposes The removal of the shoals being of much greater importance, the other was left undone.

Work was suspended from November until February, as a dredge-boat could not be secured.

Towards the end of November a dredge-boat was hired in Baltimore, Md., to begin work on the 1st of January, but rough weather and dangerous navigation delayed its arrival until the 10th of February.

Since that time about 25,000 cubic yards of material have been taken out, most of it sand, but a good portion hard marl and shell rock. Some blasting has been necessary. The work is now within less than one-quarter of a mile of Trenton, but one rock shoal about 5 miles below Trenton, already blasted, has to be removed, and several points will be required to be dredged off, in addition to completing the channel to Trenton; and it will be necessary to dig out a basin at the Trenton Landing.

It became necessary to hire a tug-boat to serve the dredge. The tug went into service last month.

The dredge costs $60 and the tug $15 the day of ten hours. Both are manned and run without other expense to the appropriation. The cost per cubic yard has been about 25 cents for removing what has been taken out. This is not a high price.

Three appropriations of $7,000, $10,000, and $5,000, respectively, have been made, which about cover the amount estimated for the whole improvement. In my last report I called attention to the circumstances attending the survey and to the amount of work which had been done, and which at that time far exceeded what had been estimated for, for the whole river.

The amount of dredging yet to be done and the completion of other necessary work will more than consume the present appropriation.

The importance of thoroughly completing the improvement of this stream to Trenton is best illustrated by reference to the report made for your information by the president of the Trent River Navigation Company at my request. In reading the statistics of last year's traffic on the river, the showing is made that the commerce over the river has doubled in two years, and that this increase is due "almost entirely to the improvement of the navigation by the United States Government."

The same report contains this statement: "It is evident that the business of other companies or private concerns has increased in like proportion."

In my judgment $5,000 more will be required to finish the projected work as it should be, when nothing more will be required for an indefinite period.

This amount is demanded on account of the large quantity of work which has been done and will be required to be done over and above that estimated for. It was hoped to keep the work within the limit of the first estimate, but the most rigid economy has failed to accomplish the result.

Below is appended the statistical report of the president of the Trent River Navigation Company.

Extract from report of C. E. Foy, president of Trent River Transportation Company, of June 23, 1881.

Articles.		Quantity.	Estimated value.
Cotton	bales	6,000	$240,000
Wool	pounds	7,000	1,750
Turpentine	barrels	1,500	3,750
Potatoes, Irish	do	2,500	6,250
Tar	do	1,000	1,500
Corn	bushels	80,000	40.000
Cotton seed	do	30,000	3,000
Meal	do	3,000	2,100
Bricks		500,000	3,000
Garden pease	boxes	200	3,000

Extract from report of C. E. Foy, &c.—Continued.

Articles.	Quantity.	Estimated value.
Other vegetables ... boxes	2,500	$2,500
Guano ... tons	1,000	40,000
Bagging ... pounds	80,000	3,000
Iron ties ... do	50,000	2,500
Salt ... sacks	2,000	2,000
Flour ... barrels	5,000	25,000
Pork ... do	1,500	27,000
Molasses ... do	600	7,200
Snuff ... do	200	1,500
Nails ... kegs	500	1,500
Rice ... bushels	5,000	4,500
Total	....	421,050

The work has been done by hired labor and machinery, other methods being impracticable.

This work is in the second collection district of the State, and the office New Berne, N. C.

I am, sir, very respectfully, your obedient servant,

R. RANSOM,
Assistant Engineer.

Capt. JAMES MERCUR,
Corps of Engineers, U. S. A.

I 12.

IMPROVEMENT OF CONTENTNEA CREEK, NORTH CAROLINA.

The river and harbor act of June 14, 1880, directed an examination or survey of this creek.

The examination was made in January last and a report on the same, together with maps and estimates of cost of improvement, was submitted February 5, 1881, and will be found in House Ex. Doc. No. 85, Forty-sixth Congress, third session.

The improvement proposed consists in the removal of all obstructions both natural and artificial, in order to secure a navigable depth of 3 feet for the eight or nine flush-water months from the mouth of the creek, where it empties into Neuse River, to the town of Stantonsburg, about 70 miles above.

The estimated cost of the improvements proposed is about $40,000.

The act of Congress approved March 3, 1881, appropriated $10,000 for this work.

A project for the expenditure of this money was submitted April 8, and has been approved by the Chief of Engineers.

The project contemplates the carrying out the work in accordance with the original plan, commencing at the mouth of the creek and continuing it as far up as funds will permit.

The work is of such a character as not to admit of exact specification, and will be conducted by the hire of machinery and labor and the purchase of material in open market.

The appropriation of March 3, 1881, is the only one that has been made for this work.

To complete the work proposed will require a further appropriation of $29,600.

Contentnea Creek is in the collection district of New Berne, N. C.

Money statement.

Amount appropriated by act approved March 3, 1881	$10,000 00
July 1, 1881, amount available	10,000 00
Amount (estimated) required for completion of existing project	30,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883	15,000 00

EXAMINATION OF MOCCASON RIVER (CONTENTNEA CREEK), A TRIBUTARY OF NEUSE RIVER, NORTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., February 5, 1881.

GENERAL: I have the honor to tranmit herewith a report upon an examination of Contentnea Creek, North Carolina, privided for by act of Congress approved June 14, 1880.

Contentnea Creek is now the generally accepted name of the stream in question, although it was formerly known as "Moccason River." By a clerical error the late river and harbor act provided for an examination of "Pocosson River," there being no such stream in the State; but by a subsequent letter I was instructed by you to consider that the intent of Congress was to call for an examination of Contentnea Creek.

As soon as possible after your instructions were received, I placed the examination in the charge of Assistant Reid Whitford, who organized a party and conducted the field work during the month of January last. Mr. Whitford has since plotted his notes, and, to accompany his report, I send you this day tracings (three in number) from his original maps, exhibiting the results of his examination.

Contentnea Creek is a tributary to the Neuse River, emptying into the latter at a point 32 miles above the city of New Berne, N. C. It drains an exceedingly fertile section of country located between the Neuse and Tar rivers. Its navigation is at present confined to flat-boats and rafts of timber, but it appears practicable to secure a reliable 3-foot depth of water, during the eight or nine "flush-water" months of the year, as high as the town of Stantonsburg, about 70 miles from the mouth of the stream. This depth can be secured at a comparatively small outlay, the estimate being a little less than $40,000. Mr. Whitford states quite fully the present obstructions to navigation, their causes, and the probable cost of the improvement required. Should the general government decide to take up this work, I deem it of special importance that the whole amount required should be given in a single appropriation, on account of the expense and risk of transferring proper machinery to the proposed points of operation.

Contentnea Creek is in the collection district of New Berne, N. C. * * *

I am, general, very respectfully, your obedient servant,
CHAS. B. PHILLIPS,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. REID WHITFORD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE.
Norfolk, Va., February 4, 1881.

CAPTAIN: I have the honor to submit, with accompanying map, the following report respecting the survey of Contentnea Creek, North Carolina, made in accordance with your orders during the month of January last.

Not being limited as to its length, I decided, after close examination, that the flourshing town of Stantonsburg, situated upon the left bank of the creek, 70 miles above its mouth and 10 miles below the Wilmington and Weldon Railroad, would be the proper initial point of the survey. Beyond Stantonsburg the creek assumes a much more abrupt fall, narrows rapidly, and is totally impassable, even at mean low-water, owing to the number of sand-shoals therein existing. Aside from this, I am told, at no time was the stream ever used above this point for the transportion of freights.

Prior to the late war, when the channel was somewhat freer from fallen timber, freights in considerable quantities were conveyed on flat-boats from this town down the creek, thence finding its way to the New Berne market.

The object of the survey was to determine the amount and nature of obstructions, to form estimates of the probable cost of removing the same, so as to furnish less dangerous navigation to light-draft boats, and, if possible, to so improve the channel as to maintain a controlling depth of 3 feet for nine months out of the twelve.

The result proves the creek to be badly choked with fallen timber, sunken logs, and snags, also obstructed by sand-bars, and navigation rendered exceedingly difficult, in many places next to impossible, by the dense overhanging growth.

Otherwise the stream, though very crooked (and of its tortuosity you can get a more correct idea by a glance at the map than any description I could write), is in very good condition, being sufficiently wide and carrying a volume of water great enough, I believe, to permit of the desired improvement with a comparatively small outlay of money.

While many acute angles occur in its various meanderings, forcing the creek to often double upon itself, still I don't think it advisable to attempt any cut-offs, for two reasons: the one because the fall would become too great for the lengths of the cut-throughs; the other, time and distance saved would not be worth the expense of the cutting.

With a knowledge of the channel, they can be safely navigated as they are.

However, the extreme points might be cleared of the timber and dredged for a short distance to a marked advantage.

Those places represented upon the map as the "lower and upper narrows" demand the most careful attention, especially the former, being immediately at and above the mouth. This portion of the creek is very narrow, contracted at times to a width of 50 feet; contains a number of short, sharp bends, and the banks on each side flatten into low grounds as Neuse River is approached. The entire width of the stream through the narrows is badly obstructed by sand-bars, fallen timber, and overlapping trees. At this point Neuse River is within a few hundred feet of the creek, and the accumulation of sand in the channel appears to have been principally caused by numerous break-throughs or sloughs from that river, the current breaking through the river banks and flowing over the low grounds into the creek, which produces eddies, and hence the sand deposits.

I am satisfied that were these sloughs securely diked with cheap structures of piles, logs, and brush, then dredge the sand-bars in creek, the river water would be dammed out, and the velocity of the current in the creek would be so increased as to send the water out of its mouth with such violence that whatever sands there might be floating in the future would reach the jetties constructed in the Neuse a short distance below, and be dropped in their eddies and not in mouth of creek as heretofore by mingling of creek and river waters.

Thus it seems that the spread of the creek water being prevented, the depth gained by dredging would remain permanent.

The upper narrows are not so badly obstructed as the lower, still not a little work is required there in removing sunken logs, &c., from channel, trimming trees, and protecting the caving banks from the action of the current.

There are caving banks at other points needing attention, though for the most part they are high, firm, and in some instances composed entirely of hard blue "marl," with which material, doubtless, the bed of the creek is underlain.

Sloughs are sudden depressions in the banks, having the appearance of small streams or feeders, from 10 to 100 feet wide at their mouths. At low-water these are dry, but in higher or rising water the current is attracted into them, and thus the velocity of the flow is so slackened as to cause eddies which almost invariable form a sand-bar just below. After mature observation, I am of the opinion that were the mouths of these sloughs diked in a manner before stated, and the sand-bars disposed of by dredging, the depth acquired would be lasting.

The foregoing facts reduce themselves to three simple questions to be considered for the improvement of the creek, namely:

Dredging, diking, removing falling timber, and trimming leaning trees; and estimates for the probable cost of accomplishing the same I believe to be as follows:

Dredging 50,000 cubic yards, at 25 cents per yard	$12,500
Diking 7,000 linear feet, at 50 cents per foot	3,500
Fallen trees to be removed, 1,200, at $5 each	6,000

Fallen trees to be removed, 2,000, at $2	$4,000
Stumps and trees with roots, 50, at $10	500
Overhanging trees to trim, 4,500, at $2	9,000
Clearing points and grubbing	500
	36,000
Superintendence and contingencies, add 10 per cent	3,600
Total	39,600

Contentnea Creek, or, as it is often called, Moccason River, and its dimensions are such as to warrant it to be termed a river, a stream of importance in North Carolina, rises in the northwest, flows in a general direction of southeast, and empties its waters into the river Neuse, 32 miles above the city of New Berne, being one of that river's boldest tributaries; in its course the creek passes through the fertile counties of Wilson, Greene, Pitt, Lenoir, and a part of Craven, draining that country lying between the Tar and Neuse rivers, not surpassed by any in the State for farming purposes.

The soil is of a rich, dark hue, well adapted to the cultivation of rice, cotton, tobacco, corn, wheat, potatoes, &c.

Not a few highly-tilled plantations, containing vast areas of valuable cleared lands, are within easy reach of the creek, and its banks, with some of the country, are covered with forests of such heavy timber as pine, cypress, oak, &c., in almost inexhaustible quantities.

The raising and exportation of rice, a new industry springing up in that section, is fast gaining a magnitude second only to that of cotton.

The country being without the convenience of railroads, its people have long and distressingly experienced the need of a cheap, easy, and sure mode of transportation for their freights. Naturally they look to Contentnea Creek to relieve this want.

You will not be astonished at their anxiety for the improvement of their stream when you learn that they are compelled to haul by wagon, that old-fashioned, tedious, and uncertain, as well as expensive, way, all their products and supplies a distance of some 15 miles or more to and from markets.

In days gone by, when both Neuse River and Contentnea Creek were in a much superior condition for navigation, an extensive trade was successfully conducted between New Berne and the Contentnea regions, but of late years this has totally ceased on account of the collection and formation of many obstructions in both water courses.

The satisfactory result of the works now progressing upon Neuse River have aroused the interest of the people in the Contentnea country and caused them to become doubly anxious for the improvement of their stream in order that they may be able to renew the lucrative trade by the way of that river. I am informed by Mr. William Coward, a gentleman of influence and chairman of the board of commissioners for Greene County, that his county ranked number two in the agricultural reports of all the counties, to the Commissioner of Agriculture, of North Carolina.

From the most prominent business men I learn that from Greene County alone, at least 15,000 bales of cotton are yearly produced and shipped to distant points, besides other freights; of this amount of cotton about 5,000 bales leave Snow Hill, the county seat, a thrifty, growing town, 35 miles from Stantonsburg, and about 3,000 bales from Hookerton, a village surrounded by a thickly-settled country, 45 miles from Stantonsburg. The remainder goes from various other points in the county. From Wilson, Lenoir, Pitt, and Craven about 10,000 bales, and about half of this is sent from Stantonsburg.

If the creek could be navigated the above figures would be largely increased, it is said; and in addition many shingles, with much lumber, timber, and also hundreds of tons of inward freights would be annually boated over it. Thus it seems reasonable that the improvement of Contentnea Creek would be the means of developing and bringing to light many resources of this rich country heretofore hidden, and in the end be of benefit not only to that immediate country, but also to the profit of the State, and hence to the Government of the United States.

Very respectfully, your obedient servant,

REID WHITFORD,
Assistant Engineer.

Capt. CHARLES B. PHILLIPS,
Corps of Engineers, U. S. A.

I 13.

IMPROVEMENT OF BEAUFORT HARBOR, NORTH CAROLINA.

The act of Congress approved June 14, 1880, directed an examination or survey of this harbor.

The survey was made during the months of November and December last, and a report thereon, accompanied by a map and estimate of cost of proposed improvement, was submitted January 29 last, and will be found printed in House Ex. Doc. No. 78, Forty-sixth Congress, third session.

The improvement proposed consists in the construction of jetties of loose rock to prevent the further abrasion of "Shackleford's Point," and to dredge two channels and a turning basin near the town of Beaufort. The estimated cost of this work is $82,103.38.

The river and harbor act of March 3, 1881, appropriated $30,000 for this work.

A project for the expenditure of this amount has been called for by the Chief of Engineers, and will be submitted as soon as some precise data with regard to the location of the jetties is obtained.

The appropriation above named is the only one that has been made for this work.

To complete the work proposed will require the further appropriation of $52,103.38.

Beaufort is a port of entry.

Money statement.

Amount appropriated by act approved March 3, 1881	$30,000 00
July 1, 1881, amount available	30,000 00
Amount (estimated) required for completion of existing project	52,103 38
Amount that can be profitably expended in fiscal year ending June 30, 1883	52,103 38

SURVEY OF BEAUFORT HARBOR, NORTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., January 29, 1881.

GENERAL: The river and harbor act approved June 14, 1880, provided for an examination or survey of Beaufort Harbor, North Carolina.

Your letter of instructions of the 17th of June last placed me in charge of the survey called for, and I assigned the execution of the work to assistant Charles M. Yeates, who conducted the survey during the months of November and December last.

I transmit herewith Mr. Yeates' report upon his survey, as well as a tracing from his map of the harbor, showing the points at which improvements are proposed and recommended.

Beaufort Harbor is a point of such importance that I propose, at no distant day, to forward to you a more finished map of the survey to replace the tracing which is now furnished for temporary use at your office.

But little water (not over 4 feet at low tide) can be carried to the wharves at the town of Beaufort; but the entrance from the sea is the first one of importance to be found going south from the Chesapeake Capes, the bar affording a reliable depth of 15 feet at low-water. The bar once crossed, a considerable greater depth can be depended upon up to Morehead City (opposite Beaufort), the seaboard terminus of the Atlantic and North Carolina Railroad.

The importance of this point was recognized at an early day, and the entrance was fortified by the general government, Fort Macon being located on its southern side. It has of late years become of more prominence, being on or near the lines of proposed interior water communication along the coast of North Carolina.

The immediate cause of the deterioration of the harbor of Beaufort appears to be the washing away of Shackleford's Point, at the entrance from the sea opposite Fort Macon. The material washed away is deposited in the harbor, and the increased width of entrance must ultimately result in the shoaling of the channel. To protect Shackleford's Point from further abrasion, and to restore it in a measure to its former condition, it is proposed to construct three jetties or spurs 200 feet in length each of loose rock. The adoption of the same plan at Fort Macon has been attended with success, and other points along the South Atlantic coast have been similarly protected.

To restore to the harbor (proper) of Beaufort its original depth of water it is proposed to dredge a channel to the wharves 9 feet in depth at low-water and 200 feet in width (giving ample space for turning at the town), and to dredge a channel 6 feet in depth at low-water and 100 feet in width back of "Horse Island" to accommodate the small craft coming from North River and Core Sound. These craft, upon which the town of Beaufort depends largely for its trade, are now often detained for long periods waiting for a favorable opportunity to cross the inlet in order to reach their destination.

Mr. Yeates' estimates for the entire cost of the work proposed above amount to $82,000. I think that this amount might well be expended in restoring to the harbor (proper) of Beaufort its original facilities for shipping, and in preventing further deterioration from natural causes, especially as the work proposed will incidentally protect other important interests referred to above.

Beaufort is a port of entry.

* * * * * * *

I am, general, very respectfully, your obedient servant,

CHAS. B. PHILLIPS,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. CHARLES M. YEATES, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., January 22, 1881.

CAPTAIN: I have the honor of submitting this my report on the survey of Beaufort Harbor, North Carolina, accompanied with a map (scale $\frac{1}{7200}$) graphically illustrating the hydrography and topography of the same.

In pursuance of your orders, I began the survey under the disadvantages of extremely inclement weather, wind, rain, cold, and fog, which continued during most of our stay at Beaufort. However, the work progressed whenever it was possible, and an accurate survey was the result.

The initial of the survey was the line between the two points as established by the United States Coast and Geodetic Survey at Fort Macon and the railroad wharf at Morehead City. From this line as a base, triangles, primary and secondary, were swung over the entire harbor from Morehead City to Middle Marsh.

A tide-gauge was established, and all the soundings in the harbor were reduced to mean low-water. The secondary triangulation located the marsh islands between Morehead City and Beaufort, through which is the course of navigation for small craft on high-tide. To the east of these islands is Gallant's Channel, and through them run Reid's Creek and Lewis's Thoroughfare, streams of considerable importance to navigation from Beaufort to Morehead City and up the Newport River.

Sounding stations were established at all important points in the harbor, and lines of soundings were taken variously between them, which, when reduced to mean low-water, gave with considerable accuracy the various channels, sloughs, shoals, and bars in the harbor.

After many unsuccessful attempts I found it impossible, with what means I had, to get as many soundings between Fort Macon and Shackleford's Point, and thence seaward, as I wished, and this on account of the very rough weather. But I succeeded in getting soundings for the channel line over the bar for a distance of about 2 miles from Fort Macon seaward. To the left of the entrance of the channel commences a shoal called the Breakers, which runs along with the channel to Fort Macon; and from the right of the channel is a shoal which extends to Shackleford's Point. In this shoal there are holes and sloughs, not, however, susceptible of improvement except at great cost, and not practicable for navigation, since the channel affords a good entrance to the harbor.

The least depth of water found in the channel over the bar is 15.3 feet (mean low-water), near the outer end. This depth is for a short distance only, and changes as Fort Macon is approached through the successive steps to 17 feet, 19 feet, 25 feet, and so on until a depth of 40 feet is attained at a distance of three-fifths of a mile from the fort. This depth changes to nothing less than 32.6 feet until after the fort is passed. Thence up to the Atlantic and North Carolina Railroad depot, at Morehead City, there is a channel of excellent width and a depth of 25 feet.

The bar channel is not as deep throughout as it should be, but where it is shallowest excavation by dredging would not on account of the shifting sand be permanent, unless the channel were walled on both sides, or unless jetties were run from Fort Macon and Shackleford's Point, a distance on one side of about 9,000 feet, and on the other 6,000 feet. Neither of these projects could be effected without a great outlay of money, and therefore, for the present, I deem it best that no recommendation for improvements on the bar be made, but that attention be turned to some other points of the harbor.

Through the kindness of Mr. William Alexander, of Beaufort, I am able to give the following interesting information:

* * * * * * *

"*Results of different surveys of the bar at the entrance of the harbor at Beaufort, N. C.*

Date.	Surveyed by—	Direction of the channel.	Depth of water on the bar.	At—
			Feet.	
Old chart.	No authority	SSW	16	
1718	Lawson	N. and S	18	Low water.
1737	Wimble	N. and S	18	Do.
1820	Kearney	S. 21° 80′ E	13	
1830	United States Army	S. 52° 16′ E	18	
1839	Lieutenant Glynn, U. S. N	S. 52° 15′ E	15	Lowest observation during spring tide.
1850	United States Coast Survey	S. ¾ W	17	Mean low-water.
1854	do		15.5	Do.
1862	do		15.5	Do.
1874	do	(*)	(*)	

*Survey in progress; no results yet ready for publication.

"The deepest draught vessel that ever entered the harbor was an English cruiser (Revolutionary war), drawing 22 feet. She was taken out again by a resident pilot, who stated that she crossed the bar with an ordinary high-tide, but struck lightly several times. In the year 1838 the ship Napoleon, bound for Liverpool with naval stores, crossed the bar with a draught of 17¼ feet.

"The heavy southwest gales of 1815 injured the bar so that but 12 feet could be carried over it at low-water. This was the most violent and disastrous gale ever known on the coast. Those of 1811 and 1813 were also severe.

"From the above statements and results it may be readily inferred that the differences in depth are attributed to local causes of a transient character, not permanently affecting the general capacity of the bar."—(W. IRVING VINAL, *United States Coast Survey.*

I also learned from the Messrs. Smith, resident pilots at Beaufort, that on the 31st of March, 1880, the ship Santiago de Cuba, draught 18 feet, capacity 1,580 tons, entered the harbor at ordinary high-tide, and cleared with scarcely any difficulty.

Before and after reaching Beaufort I learned that considerable anxiety was felt by the inhabitants as to the future of the town, on account of the rapid washing away of Shackleford's Point, thus leaving the town more exposed to the ocean. I was told by several that within the last seven or eight years the point had washed away nearly a mile.

So careful attention was given to the location of the point, and it was ascertained that since the coast survey of 1873 it has washed about 1,000 feet, and that the deposit resulting from the wash has been made in the harbor. This is deserving of notice, and it is highly important that the point as it now stands should be maintained, and if practicable be partially restored to its former condition.

I learn from General Gillmore's report on Fort Macon that more than twenty years ago five short spur jetties, formed of stone of random sizes, were built to the east and south of the fort for the security of the site, and that until quite recently they thoroughly subserved their purpose; that two have remained intact, two have settled, while the other has disappeared from sight.

An appropriation of $6,000 has been asked for to restore or renew these jetties. A project of the same kind would be sufficient for the preservation of Shackleford's Point, since its character is very similar to that of Fort Macon Point; therefore I recommend that three spur jetties, of a length of 200 feet each, be placed at the point, one on the inside, one at the end, and the other on the outside. It it estimated that the cost for stone, transportation, labor on the jetties, and contingencies will be $30 per linear foot, which makes $18,000 the total amount recommended to be expended in securing Shackleford's Point.

The storm that swept the Atlantic coast on the 18th August, 1879, was a disastrous one to the harbor and the town of Beaufort. It did not lessen the capacity of the bar channel, but, besides washing Shackleford and Fort Macon points, it seriously affected the channels and bars inside the harbor, making a bar on the left side of the southern entrance to Lewis' Thoroughfare, slightly shoaling the Bulkhead Channel and forming a bulkhead from the neighborhood of Morse's Slough up the North River Channel to Carrot's Island, thus almost entirely stopping up the eastern entrance to Town Channel, so that it is now navigable for only canoes and small sail-boats, and that, too, only on the early ebb and late flood tides. The improvement of this channel, though, will be discussed later.

Having entered the harbor, the bar channel is continued in three directions, one leading to Morehead City, one up the eastern end of the harbor affording entrance to Back Sound, Core Sound, and North River, the other going in the direction of Beaufort through the Bulkhead Channel. This channel has a depth of at least 9 feet, up to its end at Town Marsh; but from that point navigation over to Beaufort is impeded. You will find by inspection of the map herewith submitted the channel best susceptible of improvement, and upon which I have made estimates for a width of 200 feet and a depth of 9 feet at ordinary low-water. Commencing near the west end of Town Marsh it runs parallel to the marsh for a distance of 1,375 feet, thence over to a point 575 feet from, and opposite, the central wharves of Beaufort; and from this point I have estimated for excavation so that there will be an area or turning space along the wharves for a distance of 650 feet with an ample but regularly varying width. A correct idea of this can best be gotten from a glance at the map.

The cost of improving this channel is given thus:

147,686 cubic yards mud and sand dredging, 20 cents per yard	$29,537 20
For engineering and contingencies add 10 per cent	2,953 72
Total amount	32,490 92

TOWN CHANNEL.

It has been before noticed in this report that the storm of August 18, 1879, produced such effect upon the eastern entrance of this channel that it is now very shallow. That this channel, or a portion of it, in connection with one that I shall shortly mention, should be opened, is not only of much importance to the town of Beaufort, but also to the people who live on the North River and the straits. Nearly all these people take their produce to Beaufort, and, as the channel is now, they must make the trips in canoes and flats, and wait, too, for high-tide before they can enter the channel.

It is not advisable that the general government should at this time excavate the channel to a depth of 9 feet, but the following project seems worthy of recommendation.

From an inspection of the maps it will be seen that the 6-foot contour runs off from the wharves of Beaufort in the direction of Town Channel. It is hereby recommended that from the eastern extremity of this contour a channel with depth of 6 feet, mean low-water, and width of 100 feet, shall be excavated down the old Town Channel until nearly opposite the western end of Horse Island, thence through the creek north of the island and out to the 6-foot contour which soon conjoins with the channel up the North River and through the straits. The reasons for this project are apparent. The first part of the proposed channel would not be subjected to the influence of storms, since it is protected by Town Marsh and Bird Island Shoal, or the high land of the shoal; but if the latter part of the excavations were through the old channel, *i. e.*, to the south of Horse Island, the channel thus formed would have no natural protection, since different surveys show that it is subjected to the influences of the winds, having shoaled considerably within the last two years. But the continuation of the channel herein proposed would have ample protection by Horse Island and could be maintained without trouble. Below is an illustration of costs for the proposed improvements:

143,693 cubic yards mud and sand dredging, 20 cents per yard	$28,738 60
For engineering and contingencies add 10 per cent	2,873 86
Total amount	31,612 46

Thus the cost for the entire amount of excavation as recommended in this report will be $64,103.38, and the cost of the jetties at Shackleford's Point $18,000, making $82,103.38, the total amount recommended to be expended in the present improvement of Beaufort Harbor.

Beaufort is a village of about 2,000 inhabitants, and is best known as a summer resort. It has a good commerce, shipping fish and oysters to the various cities as far north as New York, while, as a shipping point for rice, it is making rapid strides. It has no line of steamers, but does quite a good business through the instrumentality of sailing craft.

Morehead City, however, has a line of steamers with New York; making eight-day trips, but does not clear much sail.

I am, sir, very respectfully, your obedient servant,

CHAS. M. YEATES,
Assistant Engineer.

Capt. CHARLES B. PHILLIPS,
Corps of Engineers, U. S. A.

I 14.

IMPROVEMENT OF THE CAPE FEAR RIVER, FROM WILMINGTON TO FAYETTEVILLE, NORTH CAROLINA.

The act of Congress approved June 14, 1880, directed an examination or survey of this portion of the river—

> With a view of ascertaining cost and practicability of clearing away logs and overgrowing trees, and of dredging out such shoals as now interfere with commerce, itemizing cost of each separately.

An examination was made in January last, and a report accompanied by maps and estimate of cost of proposed improvement was submitted to the Chief of Engineers January 26, and will be found printed in House Ex. Doc. No. 78, Forty-Sixth Congress, third session.

The improvements proposed consist in the removal of snags and sunken logs, the clearing of the banks of overhanging trees, a small amount of dredging and the construction of experimental dike in the upper and shoal portions of the stream.

The estimated cost of the work proposed was $55,755.00; this, however, was only for a part of the work that will be required for the entire improvement.

The river and harbor act of March 3, 1881, appropriated $30,000 for this work—

> *Provided,* That the Secretary of War is directed to expend of the money hereby appropriated, a sum not exceeding $10,000 to extinguish any claim of right held by any company or corporation, to take tolls or make charges for the navigation of so much

of said river, as is above described: *And provided further*, That said claim of right shall be extinguished and released on or before the first day of December, 1881, and no part of this appropriation shall be expended in the improvement of said river until such claim of right is wholly extinguished and released: *Provided further*, That nothing herein contained shall be taken or held as a waiver on the part of the United States to the exclusive control of navigation of said river, relieved from any charges or tolls imposed by any company or corporation.

A project for the expenditure of this amount of this appropriation has been called for by the Chief of Engineers but has not been submitted, pending negotiations with parties who control the franchises referred to in the appropriation.

The appropriation named herein is the only one that has been made for this portion of the Cape Fear River.

The Cape Fear River is in the collection district of Wilmington, N. C.

Money statement.

Amount appropriated by act approved March 3, 1881	$30,000 00
July 1, 1881, amount available	30,000 00
Amount (estimated) required for completion of existing project	35,755 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.	35,755 00

EXAMINATION OF CAPE FEAR RIVER, NORTH CAROLINA, BETWEEN WILMINGTON AND FAYETTEVILLE.

UNITED STATES ENGINEER OFFICE,
Norfork, Va., January 26, 1881.

GENERAL: The river and harbor act approved June 14, 1880, called for an examination or survey of "the Cape Fear River, North Carolina, between Wilmington and Fayetteville, with a view of ascertaining cost and practicability of clearing away logs and overhanging trees, and of dredging out such shoals as now interfere with commerce, itemizing cost of each separately."

As operations were suspended on most of the works in my charge in this vicinity on account of the severity of the weather, I was fortunate in being able to intrust the examination to Mr. George H. Elliott, assistant engineer.

Tracings, eleven in number, exhibiting the present condition of the river between the points indicated in the appropriation act referred to above, are transmitted to you this day.

Mr. Elliott's report upon the examination in question is given below, as follows:

NORFOLK, VA., *January* 24, 1881.

CAPTAIN: I have the honor to submit herewith report of an examination of the Cape Fear River, North Carolina, between Wilmington and Fayetteville, made in compliance with your instructions in the early part of the present month. This examination was for the purpose "of ascertaining the cost and practicability of clearing away logs and overhanging trees, and of dredging out such shoals as interfere with commerce."

A survey of this river was made in 1871, when that portion of it now under consideration was carefully sounded. It was thought that no material change had taken place in the general character since that time, and that a resurvey would be unnecessary; and the testimony of pilots and others conversant with the river is to this effect. The examination was therefore limited to ascertaining, so far as practicable, the number of snags, sunken logs, and overhanging trees to be removed.

A freshet which had commenced to raise the water in the river prevented the observations being as thorough as was desirable, but it is believed that the information obtained from pilots and captains is as satisfactory with regard to the objects at present in view as could be had except from an expensive survey, which would have to include the dragging of the river, to ascertain with any exactness the number of sunken logs and snags. Under these circumstances trips were made up and down the river between Wilmington and Fayetteville, when notes were taken as to the locality of such snags, &c., as they (the pilots) had knowledge of; these are indicated on the charts herewith (11 in number), which are tracings of the maps of the survey of 1871, with such slight changes as have been found necessary. A tabulated list of the snags is also given at the end of this report.

In addition to the snags, &c., which are individually mentioned, there are several stretches of the river where such obstructions exist; these are also stated in the list.

The overhanging trees are very frequent from Fayetteville for some 60 miles down the river; below that they are less so. Few of the trees are large, and at present they do not much obstruct navigation, but their tendency is to fall into the river when the banks are weakened by the action of the freshet water; for this reason a large number of them ought to be removed.

The bed of the river for some 66 miles below Fayetteville is composed almost entirely of sand, which is constantly changing in position from the action of freshets. During the summer months the volume of water is insufficient to give a continuous channel, the river then presenting a succession of sand bars and shoals with occasional deep water, principally in the bends.

Any improvement, to be permanent, will necessitate the contraction of the channel way in many of the straight reaches over a large portion of the distance named.

With the exception of one place (Thames' Shoal), dredging would be useless, as the first freshet would fill up any channel excavated through the shifting sand. Thames' Shoal is a bed of pipe-clay, through which it is proposed to dredge a channel of 60 feet in width to a depth of 5 feet at low summer water. The bed of the river contains also many sunken logs, under the sand in some cases, as is stated by the pilots who have been engaged in removing snags, &c., overlying each other; to what extent cannot well be ascertained except by actual operations in removing them.

The improvements needed in the river are confined principally to the 75 miles from Fayetteville down; over this entire portion the banks need trimming of the overhanging trees, and snags and logs should be removed from the river-bed. To accomplish this work will require the employment of a hoister with the necessary appliances for dragging the bottom to find and raise snags, &c. This work can only be done satisfactorily at a low stage of water, and will cost about $500 per mile; an estimate for this sum is submitted. As previously stated, there is no continuous channel for some 60 miles, and to provide one will require the contraction of the water-way. I am not prepared to submit an estimate for this entire work, but respectfully suggest that an amount of $5,000 be appropriated for the construction of experimental jetties or dikes of cheap character to be placed at right angles to the axis of the stream, at intervals, from either side, to be built a little above the ordinary low summer water, and to be placed first in the shoalest of the straight reaches. Dikes of piles wattled between have proved quite successful in other rivers of similar character, and can be constructed for about $1 per running foot.

An estimate is also submitted for the excavation of a channel through Thames' Shoal (previously mentioned).

I would mention, incidentally, that while on the river the steamer Governor Worth struck a log which had lodged in a tree near Council's Bluff, and, after running about 1¼ miles, sunk; the locality of the wreck is indicated on chart. She will doubtless be raised by her owners as soon as the freshet subsides.

ESTIMATE.

For clearing 75 miles of river, at $500 per mile	$37,500 00
For dredging at Thames' Shoal channel, 1,900 feet by 60 feet, 15,000 cubic yards, at 40 cents	6,000 00
For construction of experimental dike, say 5,000 linear feet, at $1 per foot	5,000 00
	48,500 00
And for contingencies and engineering 15 per cent	7,275 00
Total	55,775 00

* * * * * * *

Fayetteville, the head of steamboat navigation proper, is situated about a mile from the river, 113 miles above Wilmington. It is a flourishing town, with a population of some 7,000, and is, next to Wilmington, the principal depot for naval stores in the State. Within a few miles are several cotton and woolen mills, and others are now projected. For miles in either direction turpentine distilleries are found. Cotton is raised to a considerable extent in the vicinity; it is estimated that 10,000 bales will be brought in for shipment this season, and the production is continually increasing.

There is also quite an extensive industry in flouring mills, the product of which is shipped in considerable quantities. Five steamers are regularly engaged plying between Wilmington and Fayetteville; these, with one exception (the Governor Worth, a side-wheel steamer), are stern-wheel boats, with a load draught of something less than 4 feet. There is also railroad communication with the seaboard via Raleigh and Weldon at Norfolk. Full statistics of the commerce of Fayetteville and the river generally were expected to be furnished by parties engaged in the shipping interests, but have not yet been received. This is to be regretted, as from what the writer learned in conversation they would show a very marked increase over those obtained in 1871.

The only town between Wilmington and Fayetteville is Elizabeth, the county seat of Bladen; a small population is scattered in the vicinity engaged in the manufacture of naval stores which are brought here for shipment. River landings are very numerous, there being about one hundred on the river, most of which are places for shipment of the staple of this section.

* * * * * * *

Very respectfully, your obedient servant,

GEO. H. ELLIOTT,
Assistant Engineer.

Capt. CHAS. B. PHILLIPS,
Corps of Engineers, U. S. A.

Mr. Elliott's report, as given above, is so much in detail that I deem it unnecessary to add to it, except to say that I concur with him in his views regarding the needed improvement of the river, and that I think that the expenditure of the amount of his estimate ($56,000) would be judicious. Should the appropriation be made, some special study will be requisite in order to fix the exact location of the experimental jetties proposed.

This river was carefully surveyed under the direction of Col. W. P. Craighill, Corps of Engineers, during the year 1871, by Mr. Elliott.

Reports upon the survey will be found printed in the Report of the Chief of Engineers for 1872, pages 741–9, inclusive. Attention is respectfully called to the same.

The Cape Fear River is in the collection district of Wilmington, N. C.

I am, general, very respectfully, your obedient servant,

CHAS. B. PHILLIPS,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

I 15.

IMPROVEMENT OF LILLINGTON RIVER, NORTH CAROLINA.

The act of Congress approved June 14, 1880, directed an examination or survey of this river.

This examination was made during August of that year and a report upon same, together with maps, plan, and estimate of cost of proposed improvement, was submitted January 29, 1881, and was printed in House Ex. Doc. No. 78, Forty-sixth Congress, third session.

The improvement proposed consists in clearing out snags and logs, cutting down overhanging trees and the dredging off of a few abrupt points with a view to secure a 5-foot navigation from the mouth of the river where it empties into the Cape Fear to the village of Lillington, a fraction over 11 miles above.

The entire estimate for the proposed improvement is $6,003.75.

The act of Congress of March 3, 1881, appropriated $3,000 for this work. A project for the expenditure of this sum was submitted April 7. The project contemplates the carrying out of the work indicated above, commencing at the mouth of the river and working as far up as funds will permit.

As the work is of such a character as not to be susceptible of exact specifications, it will be conducted by the hire of machinery and the purchase of material in open market.

The appropriation herein referred to is the only one that has been made for this work.

To complete the work proposed will require the further appropriation of $3,003.75.

Lillington River is in the collection district of Wilmington, N. C.

Money statement.

Amount appropriated by act approved March 3, 1881	$3,000 00
July 1, 1881, amount available	3,000 00
Amount (estimated) required for completion of existing project	3,003 75
Amount that can be profitably expended in fiscal year ending June 30, 1883	3,003 75

EXAMINATION OF LILLINGTON RIVER, NORTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., January 29, 1881.

GENERAL: Your letter of the 17th of June, 1880, placed me in charge of the examination or survey of Lillington River, North Carolina, provided for in the last river and harbor appropriation act of Congress.

I intrusted the examination to a party in charge of Assistant J. P. Darling, who took up and completed the field work during the month of August last. * * *

His report, as well as tracings, two in number, from his original map exhibiting the present condition of the river, and the localities of the proposed improvements, are respectfully transmitted herewith.

Lillington River is a tributary to the northeast branch of the Cape Fear River, emptying into the latter from the west, at a point about 12 miles above the city of Wilmington, N. C.

Transportation upon the river is at present limited to rafts of timber and flat-boats, loaded chiefly with naval stores and cord-wood.

Above the village of Lillington, a little over 11 miles from the mouth of the river, it appears to be impracticable to attempt any improvement of the river; or at least the amount of trade both present and prospective does not seem to warrant any expediture upon the portion of the river in question.

Below the village of Lillington, and from thence to the mouth of the river, the trade is of more importance, and it would no doubt be greatly stimulated if the produce of the vicinity could be reached by light-draught steamboats. The obstructions to a 5-foot navigation, outside of a few snags and leaning trees, consist solely in a few abrupt bends, which can be rectified at a slight expense by dredging at six points, which are indicated upon the accompanying tracings.

Mr. Darling's estimate for the whole work, including dredging and the removal of snags and other obstructions, amounts to but $6,000.

The estimate seems to be low, but as he has allowed a large margin for contingencies, I think the amount sufficient to cover the cost of the desired improvements; and it appears to me that the amount might well be devoted to developing the section of country adjacent to the river.

Lillington River is in the collection district of Wilmington, N. C. * * *

I am, general, very respectfully, your obedient servant,

CHAS. B. PHILLIPS,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. JOHN P. DARLING, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., January 28, 1881.

CAPTAIN: I have the honor to submit the following repot, with accompanying tracings, two in number, of the examination of Lillington River, Pender County, North Carolina, made under your direction in August last.

Having secured the men and boats necessary at Wilmington, I proceeded up the northeast branch of the Cape Fear River, entering the Lillington on the left, about 12 miles above Wilmington. We proceeded to the head of navigation, where is situated the town of Lillington (consisting of about two dozen houses), from whence the river takes its name, having formerly been known as Long Creek.

We pitched camp at Lillington, and took a day for examination above the county bridge, which crosses at this point. By poling and dragging our boats through narrow and shallow places we were enabled to force them up the stream for a distance of 3.26 miles above the bridge, and here commenced our work.

The Lillington we found to be a drain from the lowlands and swamp lakes of Upper Pender County, running through a belt of swamp land to its mouth. The swamp averages about 300 yards in width below the bridge, but above it widens to 10 miles. The river takes a southerly course to "Jump-and-Run" Creek, then bears westerly until it reaches Riley's Creek, where it takes a southeasterly course to its mouth.

To the county bridge, at Lillington, we found the stream crooked and in places very shoal and narrow, its width varying from 10 to 100 feet, and its depth from 0.2 to 12 feet, with an average fall of about 1.5 feet per mile. It would be impossible to make anything like an accurate estimate for improving this part of the river without a careful survey; and as the amount of commerce would be very small, except in the item of timber, I do not think it necessary.

At Lillington Bridge the tide rises and falls 1.4 feet. From here to its confluence with the Northeast Cape Fear the river is a deep, wide, tide-water stream, with a few sharp bends and narrow places, its width varying from 50 to 300 feet, and depth from 7 to 42 feet. Two creeks making in on the left, and one on the right, help to deepen and enlarge the channel. The largest of these, namely, Riley's Creek, is about 10 miles long, and is said to be navigable to flats for a distance of 4 miles.

I propose to partially cut away three points, and to make three cuts through narrow necks of land formed by sharp bends in the river. These are all shown on the tracings in *red*.

Point No. 1 is just below Lilligton Lower Landing; Nos. 2 and 3 at Bee Bluff; cut No. 1 is situated just above "Jump-and-Run" Creek; No. 2 is half way between "Jump-and-Run" and Taylor's Landing; No. 3 is a short distance below Sykes' Landing. All of these are to be cut to a depth of 5 feet at low-water, the cuts to a width of 60 feet. The banks are low (about 2 feet high) and swampy.

Having made these cuts and removed the few logs, snags, and leaning trees, the river will be navigable for steamers not drawing over 5 feet of water as far up as the Lillington Bridge.

The following is the detailed estimate for proposed improvement:

Place.	Number.	Description.	Cost.	Amount.
Cut No. 1	2,611 cubic yards	Dredging	$0 25	$652 75
Cut No. 2	1,740 cubic yards	do	25	435 00
Cut No. 3	3,480 cubic yards	do	25	870 00
Point No. 1	678 cubic yards	do	25	169 50
Point No. 2	696 cubic yards	do	25	174 00
Point No. 3	783 cubic yards	do	25	195 75
	56 snags	Removing	5 00	280 00
	58 logs	do	3 00	174 00
	926 leaning trees	do	2 00	1,852 00
				4,803 00
Add 25 per cent. for contingencies				1,200 75
Total				6,003 75

* * * * * * *

Below will be found the amount of shipping from the town of Lillington during the year 1879:

Bales of cotton	12
Bushels peanuts	500
Shingles	52,000
Barrels crude turpentine	7,694
Barrels tar	4,200
Bushels rice	276
Oak staves	52,000
Cords wood	2,800
Feet timber	200,000
Chickens	2,200
Dozen eggs	1,100

The amount of staves, wood, and timber shipped is estimated, as there was no record kept of said articles.

Very respectfully, your obedient servant,

JNO. P. DARLING,
Assistant Engineer.

Capt. CHARLES B. PHILLIPS,
Corps of Engineers, U. S. A.

I 16.

IMPROVEMENT OF TOWN CREEK, NORTH CAROLINA.

An examination or survey of Town Creek, North Carolina, was directed in the river and harbor act approved June 14, 1880.

This survey was made in September, 1880, and a report upon same accompanied by plan and estimate of cost of improvement was submitted January 24 last, and may be found printed in House Ex. Doc. No. 78, Forty-sixth Congress, third session.

The improvement proposed consists in removing all obstructions to a 4-foot navigation at ordinary low tide from the mouth of the creek, where it empties into the Cape Fear, to "Saw Pit Landing," about 20 miles above.

The estimated cost of the proposed improvement is $9,078.48.

The act of Congress of March 3, 1881, appropriated $1,000 for this work. A project for the expenditure of this sum was submitted April 7, and has been approved by the Chief of Engineers.

The project contemplates the carrying out of the work indicated above, commencing at those points most pressingly in need of improvement. On account of the varied character of the work, it will be conducted by the hire of machinery and labor and the purchase of material in open market.

The appropriation referred to above is the only one that has been made for this work.

To complete the work proposed will require the further appropriation of $8,078.48.

Town Creek is in the collection district of Wilmington, N. C.

Money statement.

Amount appropriated by act approved March 3, 1881	$1,000 00
July 1, 1881, amount available	1,000 00
Amount (estimated) required for completion of existing project	8,078 48
Amount that can be profitably expended in fiscal year ending June 30, 1883.	8,078 48

SURVEY OF TOWN CREEK, NORTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., January 24, 1881.

GENERAL: Your letter of June 17, last, placed me in charge of an examination or survey of Town Creek, North Carolina, "to ascertain cost of taking out such shoals as interfered with ordinary river steamboat traffic," said examination or survey having been provided for in the river and harbor act approved June 14, 1880.

The stream being a short one, I found it practicable to make a complete survey of it, and I intrusted the work to a party already in the field in charge of Mr. J. P. Darling, assistant engineer. His map and his accompanying report are respectfully transmitted herewith.

Town Creek is a tributary to the Cape Fear River, emptying into the latter from the west at a point about 8 miles below the city of Wilmington, N. C. At present the stream is navigated only by a few small flat-boats engaged in the transportation of naval stores and cord-wood. Cotton and rice are cultivated to a considerable extent along the banks, but these products are sent to market at Wilmington mainly overland.

At the entrance to the creek there is no obstruction to navigation by steamboats drawing 5 feet of water at ordinary low-tide, and the same depth exists to a point known as "Hog-Wallow Landing," the only obstructions being sunken logs, snags, and overhanging trees.

Above the latter-named point, and between it and "Saw Pit Landing," 5 miles farther up the stream (the highest point to which steamboat navigation can be made practicable), four shoals are encountered. To excavate through these a channel 60 feet in width at bottom, and 4 feet in depth at low-water, would require the removal of about 9,000 cubic yards of material. Mr. Darling's estimate of cost of this excavation, as well as cost of removal of 121 snags, 50 sunken logs, 2,213 overhanging trees, and two sunken flat-boats, amounts to a trifle over $9,000.

The expenditure of the above amount would do much to develop a valuable section of country.

The lighters now navigating the creek are not required to be registered at the custom-house, and so no authentic statistics as to the present commerce of the creek can be obtained.

Should the creek be improved for steamboat navigation much of the overland traffic would no doubt be diverted to the cheaper mode of transportation by water.

Town Creek is in the collection district of Wilmington, N. C.

I am, general, very respectfully, your obedient servant,

CHAS. B. PHILLIPS,
Captain of Engineers.

The CHIEF OF ENGINEERS, *U. S. A.*

REPORT OF MR. JOHN P. DARLING, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., January 22, 1881.

CAPTAIN: I beg leave to submit my report of the survey of Town Creek, North Carolina, made in accordance with your instructions in September, 1880, with accompanying tracing.

Town Creek is a tide-water stream, there being a slight rise and fall of the tide as far up as Saw Pit Landing, which I made the initial point of my survey. Above this point the creek forks, making several, small, crooked, and shallow streams through the swamps, which are on about the same level with the water.

From Saw Pit Landing the creek takes an easterly course through Brunswick County, emptying into the Cape Fear River at the head of Campbell's Island, about 8 miles below Wilmington, N. C., which is the market for the produce of this section of the country, consisting chiefly of cotton, rice, and naval stores. Nearly all of these are now transported across the country by wagon a distance of 12 to 15 miles.

There are two or three flat-boats on the creek, but it takes them so long (about a week) to make a trip (as they have to wait for the tide) that they carry little of the freight.

The width of the creek varies from 40 to 450 feet, but the general average is about 125 feet. Cultivated land extends along the banks on the upper part of the creek from Saw Pit to Pine Bluff. Below that point swamps and rice-fields extend to the mouth.

The principal obstructions to navigation are logs, snags, and shoals. The shoals, four in number, are all located between the bridge and Hog-Wallow Landing, 5 miles below the initial point. They are formed by sand-bars, and are covered with grass, except in the channel. The water is good from Saw Pit Landing to the first shoal, 1,500 feet below the bridge, at Russell's Landing. This shoal is 150 feet in length, with 30 to 35 feet width of channel, and 3.3 feet of water. Shoal No. 2 occurs 2,250 feet below the bridge, is 190 feet long, width of channel 30 feet, and depth of water 1.6 feet. No. 3 is at Tar Landing. This shoal is 700 feet long, and would require the dredging of a new channel, as the old one is very crooked and narrow.

A short distance below Snowfield there is a sand-bar formed by a sunken flat-boat. This would have to be removed.

There is still another shoal, No. 4, at a bend a short distance above Hog-Wallow Landing. This one is only 120 feet long, with a depth of 3.1 feet of water. From this landing to the mouth there is plenty of water, varying from 7 to 25 feet in depth, the only obstruction being logs and snags. There are a great many leaning trees that would need to be cut and hauled away from the banks to prevent their falling into the creek hereafter.

My estimates are for a channel 60 feet in width on the shoals and 4 feet deep at low-water.

Table of estimates for improving Town Creek, North Carolina.

Place.	Number.	Description.	Cost.	Amount.
Shoal No. 1	689 cubic yards	Dredging	$0 20	$137 80
Shoal No. 2	1,330 cubic yards	do	20	266 00
Shoal No. 3	6,637 cubic yards	do	20	1,327 40
Shoal No. 4	266 cubic yards	do	20	53 20
Removing	121 snags	Removing	5 00	605 00
Do	50 logs	do	3 00	150 00
Do	2,213 leaning trees	do	2 00	4,426 00
Do	2 sunken flat-boats	do	300 00	600 00
				7,565 40
Add 20 per cent. for contingencies				1,513 08
Total				9,078 48

* * * * * * * *

I was unable to gather any statistics of the amount of commerce, as the craft which navigate the creek are not required by law to register at the custom-house.

The port of entry for this creek is Wilmington, N. C.

Very respectfully, your obedient servant,

JNO. P. DARLING,
Assistant Engineer.

Capt. CHAS. B. PHILIPS,
Corps of Engineers, U. S. A.

I 17.

IMPROVEMENT OF YADKIN RIVER, NORTH CAROLINA.

A survey of this river was called for by the river and harbor act of June 18, 1878, and was made under the direction of Mr. S. T. Abert, United States civil engineer, in October and November of that year.

His report upon the same was submitted May 12, 1879, and was printed in the Report of the Chief of Engineers for 1879, Part 1, pages 627–648. Reference is respectfully requested to this report for details of the survey, estimates, statistics, &c.

The act of Congress of March 3, 1879, appropriated $20,000 for the work, but as there were a number of mill-dams on the river, the owners of which were unwilling to have destroyed without compensation, and no provision having been made for the same, no work was done in that year.

The act of June 14, 1880, appropriated $20,000 additional for this work, with a proviso that $6,000 of the same might be expended in purchasing mill-dams.

A personal conference with a majority of the owners of the dams showed that while, as a rule, they were not inimical to the improvement of the river, they, knowing of the $6,000 allotted for the purpose, desired compensation. There were, however, some exceptions to this rule, two in particular, who were quite willing that the dams should be removed that the river might be improved.

It was finally decided to prepare for work, and in September last the construction of machinery for this purpose was commenced, and early in November following a hoister scow with mast and boom (hand power), a scow for floating quarters, and a small stone scow had been completed.

A few experimental blasts of rock were made, as were also some examinations of the river.

The cold weather necessitated a suspension of operations until April, 1881, when the construction of additional working plant was commenced. Owing to the delays in procuring machinery active operations were not commenced until June 6, since which time to the close of the fiscal year 1¾ miles of the river have been cleared, so as to afford a channel safe and direct, 3 feet deep at low-water, and from 50 to 60 feet wide, commencing at what is known as the "Old Road bridge" crossing (a little above the North Carolina Railroad Bridge), which was selected as the initial point of operations. In addition, a working party has been engaged in making a narrow channel for the passage of the flats engaged on the work in the portions of the river above, to transport material, &c.

The work accomplished has necessitated the removal of 616 cubic yards of solid rock and 150 cubic yards of bowlders; 142 blasts were made, 240 pounds dynamite used, 272 linear feet of 1½-inch holes drilled; 55 logs, trees, and snags were also taken out of the river.

For the details of the work reference is respectfully requested to the report of Mr. W. H. James, assistant engineer in immediate charge, forwarded herewith.

The river and harbor act of March 3, 1881, appropriated $12,000 for continuing this work.

A project for the expenditure of this sum was submitted April 2, which contemplates carrying out the original plan of improvement, viz, to provide a channel 2½ to 3 feet in depth through the numerous ledges of rock and shoals in the river.

This project was approved by the Chief of Engineers, and the work will be conducted accordingly.

As in the past, the work will continue to be conducted by the hire of machinery and labor and the purchase of material in open market.

The appropriations for the work have been—

March 3, 1879	$20,000 00
June 14, 1880	20,000 00
March 3, 1881	12,000 00

Money statement.

July 1, 1880, amount available	$40,000 00	
Amount appropriated by act approved March 3, 1881	12,000 00	
		$52,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	4,275 61	
July 1, 1881, outstanding liabilities	4,105 28	
		8,380 89
July 1, 1881, amount available		43,619 11
Amount (estimated) required for completion of existing project		36,000 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		36,000 00

REPORT OF MR. WILLIAM H. JAMES, ASSISTANT ENGINEER.

SALISBURY, N. C., *July* 1, 1881.

CAPTAIN: I have the honor to submit annual report of operations in improving the Yadkin River, North Carolina, during the year ending 30th June, 1881.

For improving Yadkin River an appropriation of $20,000 was made March 3, 1879. Another of $20,000 was made June 14, 1880, and a third of $12,000 March 3, 1881.

A survey of the Yadkin River was made in the autumn of 1878, for a full report of which, and estimates for improvement, the resources and productions of the country, &c., reference is made to the annual report of the Chief of Engineers for 1879, Appendix G 16.

The project under which work has been done under the two first appropriations is "to provide a channel of 2½ to 3 feet depth at mean low-water for light-draught steamers, by means of rock and gravel excavations and the construction of wing-dams where necessary, from the railroad crossing near Salisbury, N. C., to the foot of Bean Shoal" (a distance of 64½ miles); "also the removal of such snags and overhanging trees as may be encountered."

For the reasons set forth in the last Annual Report of 1880, Appendix H 17, that "no definite understanding as to the amount of claims for damages to citizens owning dams crossing this portion of the river by the proposed improvement had been arrived at, and to avoid any subsequent claims for such damages to existing structures on the part of the mill-owners," no portion of the first-named appropriation had been expended up to 30th June, 1880.

There appearing no prospect of coming to an understanding with mill-owners, in September last it was deemed advisable by the engineer officer in general charge to make preparations for work, partly with a view to stimulate these mill-owners to coming to some conclusion; and in pursuance thereof a hoister-scow, with mast and boom and hand capstan, purchased; also a floating quarters-scow, suited to accommodate some thirty men, and a small scow for transporting stone were constructed, and some examinations of the river made by Mr. Frank Brown, the overseer in immediate charge at the time. Except examinations of the river, nothing further was done until April, 1881, during which month materials were ordered and some collected for completing the required plant for work.

On the 15th April I received orders from the late Capt. C. B. Phillips, Corps of Engineers, to proceed to Salisbury, N. C., and take immediate charge of "improving Yadkin River"; which I formally did on the 25th April, 1881.

The construction of a second hoister-scow, with hand capstan power and equipments, a floating quarters-scow for about fifty men, and four scows for transporting stone, was at once commenced and pushed to completion; also two "Becket and McDowell" steam hoisting-engines of nominally fourteen horse-power each, and two Rand steam drills bargained for, to be delivered here by 27th May last, but only received on the 26th June, 1881. This machinery will at once be put on hoister-scows, and will greatly facilitate work.

Plans are being prepared, but not yet matured, for an attachment to one of the hoisters for light dredging, which attachment will not probably be needed for this season. On 6th June last work on the river was commenced, with a hand-power hoister and stone and quarter scows, at a point near and above the piers of "Old Road Bridge" (a little above railroad-bridge crossing), which point for commencing operations was selected for the reason that the management of the North Carolina Railroad Company propose to build a turn-out up to this point, as the most suitable one for making connection with steamers on the Yadkin.

Since June 6, three ledges of hard rock have been cut through, one near and above

Sower's Ferry, and two near and above Old Road Bridge, with a straight channel through them of from 50 to 60 feet clear width; and a quantity of bowlders, trees, logs, and snags taken out from the bottom of the river, giving a safe and very direct channel-way of 3 feet depth at mean low-water along the river near left bank for a distance of 1¾ miles up and above Old Road Bridge. In this work 600 cubic yards of solid rock were blasted and removed, and 150 cubic yards bowlders and 55 trees, logs, and snags taken out; 125 blasts made, 250 linear feet of 1¼-inch holes drilled, and 225 pounds dynamite used. Another force, with hoister No. 2, is opening a passage down the river from "Swicegood's Mill" to Old Road Bridge, a distance of 20.3 miles, through the numerous ledges of rock encountered; said passage to be of 25 feet width and of depth to allow free passage up and down the river for our scows and boats, for convenience of work and transportation of supplies.

On this latter work, at "Big Rock Shoal," six blasts were made, 10 linear feet drilling done, and 4 cubic yards rock removed. At "Barnes fish dam" eleven blasts were made, 12 linear feet drilling done, 12 cubic yards rock taken out, and 15 pounds dynamite used in all.

The surveys of that portion of the Yadkin River lying between "Hairston's Ferry" and the railroad bridge crossing near Salisbury appear to have been made at a flush stage of water, when it was difficult and hardly possible to make a close estimate of amount and cost of required work, and this report of work done in June, 1881, shows its amount and cost to be much greater than was contemplated in estimate. The surveys higher up the river having been made under much more favorable circumstances, estimates based upon them will doubtless approximate much more closely to cost. It is to be considered that cost of labor, materials, and hauling is much higher than at the time the survey was made, owing in great measure to the high prices now offered and paid in this region by railroads and mining companies. It has been impossible to come to any definite understanding with mill-owners as to what they will claim as damages for injuring or destroying their dams in passing, except that all above Swicegood's propose to gauge their claims by what is paid to Swicegood, who claims $3,000, which is quite too much, the mill being pretty well worn out, and the water-power can hardly be said to belong to the Swicegoods beyond the center of the river.

The owner of the right bank (Hairston) is very anxious for the improvement to go on, and authorizes and desires us to break down his end of the dam, which he claims is there only by sufference, and that hindering the improvement will be a serious injury to his property. To destroy Hairston's end of the dam and blast out a few bowlders near right-bank would very seriously injure, if not destroy, Swicegood's water-power. The improved channel should, however, be along left bank; one along right bank, though much more direct, would be very costly.

It is not improbable that Swicegood may yet consent to compromise on $1,200 or $1,500, or the cost of a steam-engine of power to run a mill of equal or greater capacity than his, in which case reasonable terms may probably be made with mill-owners above.

Very respectfully, your obedient servant,

WM. H. JAMES,
Assistant Engineer.

Capt. JAMES MERCUR,
Corps of Engineers, U. S. A.

COMMERCIAL STATISTICS.

SALISBURY, N. C., *July* 23, 1881.

CAPTAIN: The following were the principal agricultural products for the year 1880 of that part of the valley of the Yadkin River that will seek a market by way of the Yadkin when improved under existing project from the bridge of the North Carolina Railroad up to the foot of Bean Shoals, a distance of 64½ miles, viz:

Indian corn	bushels	1,003,125
Wheat	do	159,634
Oats	do	226,770
Rye	do	8,456
Buckwheat	do	301
Barley	do	57
Tobacco	pounds	1,278,311
Cotton	bales	409

Very respectfully, your obedient servant,

WM. H. JAMES,
Assistant Engineer.

Capt. JAMES MERCUR,
Corps of Engineers, U. S. A.

I 18.

IMPROVEMENT OF GREAT PEE DEE RIVER, SOUTH CAROLINA.

An appropriation of $7,000 for the improvement of this river was made by the river and harbor act of June 14, 1880. A survey of this river was ordered by the act approved March 3, 1879. The examination was made during the months of October and November, 1879, and a report upon same, accompanied by a plan and estimate of cost, was submitted March 5, 1880.

The proposed improvement consists in removing all obstructions, both natural and artificial, so as to secure a navigable depth of 9 feet as high as "Smith's Mills," about 46 miles above the confluence of the Pee Dee and Waccamaw rivers, and to secure a navigable depth of 3½ feet as high as the town of "Cheraw," a distance of 149 miles above the confluence of the rivers above mentioned.

This work was estimated to cost $25,520.

A project for the expenditure of the appropriation ($7,000) was submitted to the Chief of Engineers June 24, 1880, and by him approved.

This project contemplated carrying out the work as indicated above, and as the work was of such character as to be difficult of exact specification, it was to be done by the hire of machinery and labor and purchase of material in open market.

While the work could, without doubt, be more economically conducted by steam than hand power, the appropriation was small, and it was deemed injudicious to expend so large a portion of it as would be necessary in the construction of steam hoister, &c. Hand power was therefore resorted to, and in September last the construction of the following "plant" was commenced. One flat fitted up with hoisting derrick, one working flat, two flats for quarters, and several small boats.

This working plant was sent up the Pee Dee early in November, to "Pocket Landing," about 170 miles above Georgetown, and between "Little Bluff" and "Cheraw," which was the point on the river, according to the testimony of captains and pilots of steamers, where the obstructions to navigation were the most serious.

From the report of Mr. H. Heth, assistant engineer in charge of the work, the following extracts are made:

* * * * * * *

Work was commenced at "Pocket Landing" about the 10th of November, 1880, and prosecuted vigorously until the 1st of January, 1881. Some 250 logs and sunken trees were removed from the channel of the river, and 1 mile or more of trees, likely to be washed into the river by freshets, were felled and cut up.

The frequent rises in the river during the month of January convinced me that it would be unwise and altogether impossible to attempt to continue the work during the winter and early spring months. Work was therefore suspended during the latter part of January; all hands discharged save such as were absolutely necessary to guard the government property during the season of high-water.

* * * * * * *

The work was resumed in June 1881, and the remaining obstructions to navigation in the "Pocket," consisting of 36 large logs, two of which were blasted to release them from the sand, were taken out. A number of smaller logs were also removed. The banks of the river were also trimmed of overhanging trees.

* * * * * * *

The act of March 3, 1881, appropriating $6,000 for continuing the improvement of the Great Pee Dee, directs that the appropriation shall be expended between "Little Bluff" and "Cheraw." The next points I shall attack will be "Tiger's Head," a few miles above "Litttle Bluff;" of course between "Little Bluff" and "Cheraw," a practicable channel for steamers will be obtained at this point, by removing sunken logs and other obstructions, in the same way. I propose to proceed up the river, working at those points where navigation is now obstructed.

* * * * * * *

The articles of commerce which have passed down the Great Pee Dee by the steamers now plying on its waters during the past year are approximately as follows:

Cotton	bales	30,000
Naval stores	barrels	80,000
Lumber	feet	6,000,000 to 8,000,000

These boats have transported up the river during the same time large quantities of provisions and corn; also about 25,000 tons of guano.

It is very confidently believed, and I think with reason, that when the channel is opened to "Cheraw," as contemplated in Captain Phillips's report of March 5, 1880, the commerce on the Great Pee Dee will be greatly increased; at present many thousand bales of cotton, which would assuredly seek water transportation, are annually hauled many miles to the railroad.

* * * * * * *

The Great Pee Dee River is in the collection district of Georgetown, S. C.

The appropriations for this work have been:

June 14, 1880	$7,000 00
March 3, 1881	6,000 00
	$13,000 00

Money statement.

July 1, 1880, amount available	$7,000 00	
Amount appropriated by act approved March 3, 1881	6,000 00	
		$13,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	5,688 39	
July 1, 1881, outstanding liabilities	527 04	
		6,215 43
July 1, 1881, amount available		6,784 57
Amount (estimated) required for completion of existing project		12,520 00
Amount that can be profitably expended in fiscal year ending June 30, 1883		12,520 00

I 19.

IMPROVEMENT OF WACCAMAW RIVER, SOUTH CAROLINA.

An appropriation of $15,000 was made for the improvement of this river by act of Congress approved June 14, 1880. A survey of the river had been ordered in the river and harbor act of March 3, 1879. This survey was conducted in November and December of that year, and a report upon same, with estimated cost of improvement, was submitted to the Chief of Engineers March 6, 1880.

The plan of improvement proposed was to secure a channel 12 feet in depth from Winyah Bay to Conwayborough, a distance of 66 miles, by dredging at four shoals, the estimated amount of material to be removed being 37,400 cubic yards, and above Conwayborough to clear the river bed of obstructions, such as snags, sunken logs, &c., to cut down and clear away fallen and overhanging trees, and to remedy a few abrupt bends by simple "cut-offs."

The total estimated cost of this work was $29,370.

As the appropriation was only one-half of the estimated cost, it was deemed advisable to confine operations to the portion of the river below Conwayborough, as this would be of the greatest advantage to the interests involved. Work during the past fiscal year has been devoted to securing the necessary depth of water in the river from Winyah Bay up, the project having received the sanction of the Chief of Engineers.

In October, 1880, proposals were invited for dredging 37,400 cubic yards of material, but either the work was not of sufficient extent to justify a contractor in the risk of sending a plant to this river, or from some other cause, no bids were received. It was also found impossible to hire a dredge with the necessary outfit except at exorbitant prices. In the mean time several careful reconnaissances of the river were made by the assistant in charge, which satisfied him that dredging alone would only be a temporary benefit.

Under these circumstances a modified project was submitted to the Chief of Engineers, February 19, 1881, which contemplated the construction of jetties and dikes at the following-named localities, viz:

		Yards long.
1.	Oat Bed Shoal, jetty	250
2.	Above the shoal, dike	400
3.	Needle's Eye Shoal, jetty	300
4.	North Landing Shoal, jetty	900
5.	Boathouse Shoal, jetty	200
6.	Above the shoal, dike	150
7.	Jackson's Bluff Shoal, two jetties (Mount's Landing) each	100
8.	Above the shoal, dike	400
9.	Cox's Shoal, five jetties; total	750
10.	Dike to cut off Loggy Creek	35
11.	Little Needle's Eye Shoal, dike	100
12.	Burroughs' Cut, dike	200

It being expected that the contraction of the water-way would, by accelerating the current, scour out the sand shoals, and that dredging would not be necessary.

This modified project was duly approved, and, with the sanction of the Chief of Engineers, an open agreement was entered into with Capt. T. W. Daggett, of Conwayborough, to furnish the necessary steam hoisting and pile-driving machinery, with crew, furnish fuel, &c., at the rate of $25 per day of ten huors for such a time as it might be needed, and gave satisfaction.

From the report of the assistant engineer in charge, Mr. H. Heth, who has had the immediate supervision of the work, I make the following extracts, giving the details of the operations:

* * * * * * *

Captain Daggett commenced work in March last, the point selected was the "Needle's Eye Shoal," the worst by far between "Buck's Upper Mill" and Georgetown. Double rows of piles were driven from a point above the shoal, cutting off a marsh and creek, which caused the shoal originally to form; a second double row of piles were driven from a point on the opposite bank of the river, at an angle of about 45° with the first, the object being to contract the current (and hence accelerate it) as directly as possible upon the shoal, hoping thus to scour out a deeper channel. Before the driving of the piles necessary to complete this work was finished, the good people owning saw-mills above the work, as well as those transporting naval stores to the North, became nervous about the delay, and grumbled a good deal. I had applied for and received permission, when necessary, to employ a tug-boat to drag these shoals. I determined to avail myself of this permission, and chartered a tug at this place. On reaching the "Needle's Eye Shoal" I had the water in her forward tank pumped out; this of course depressed the stern of the tug. The tug was then tied to a tree by a hawser, and her propeller brought over the sand-bar, and work was commenced by setting the machinery in motion; the sand commenced at once to boil up, and very soon soundings showed that where we only had had 9 feet of water, we now had 12 feet. Of course a ridge was found below; this was attacked in a similar manner, and the result of the work on one low-tide gave us from 12 to 13 feet of water where only 9 and 10 feet were previously to be had. Since this work with the tug, no vessel has been detained on the much dreaded "Needle's Eye Shoal." The next work done was on the "Oat Bed Shoal," where two jetties were made similar in all respects to those on the "Needle's Eye." The space between the rows of piles is being filled up by brush, which is weighed down by logs. The jetties on the "Oat Bed Shoal," so far as driving the piles is concerned, have been completed, but the filling in is still to be done. Captain Daggett is now at work driving piles on what is known as "Mount's Landing Shoal."

* * * * * * *

The Waccamaw River takes its rise in Waccamaw Lake, North Carolina; the distance from the lake to Georgetown, S. C., is about 242 miles. The river skirts the coast its entire length, the distance from the ocean varying from 2 to 17 miles. The peninsula thus formed is very productive and said to be as fine a cattle range as can be found this side of Texas.

Large forests of live oak, white oak, and red oak are found. Phosphates and valuable marls crop out at several points on the Waccamaw. It is believed that when this river is opened to the navigation of ocean-going vessels as far up as Conwayborough a railroad will be built from this point to "Cheraw," via "Marion," Little Rock, and Benetsville. It is confidently claimed that when the present improvement is completed the business now done on the Waccamaw will be doubled in three years.

Thirty miles below Lake Waccamaw the Waccamaw branches to the eastward through "Juniper Creek," which forms a junction with "Middle River" and "Fawn Creek," thus making the Waccamaw River an important factor in the coast line interoceanic navigation. The late Capt. C. B. Philips, in his letter of March 6, 1880, to the Chief of Engineers, says, in concluding communication: "The late Lieut. Col. James Kearney, Topographical Engineers, called the attention of the government to the importance of this stream in this connection more than forty years ago."

The opening of the "Santee River" to "Winyah Bay," via Mosquito Creek, will give inside navigation from this river (the Waccamaw) to St. John, Florida; open up the Waccamaw to the Cape Fear River, then connecting with the proposed extension of the Albemarle and Chesapeake Canal, and we will have an inside route on tidewater the most of the way from Cape Cod to Florida.

The commerce on the Waccamaw is carried on by steamers and sea-going vessels drawing about 11½ feet of water. It consists mainly in the following articles and amounts annually:

Lumber	feet..	12,000,000
Shingles	number..	6,500,000
Naval stores	barrels..	108,000
Cotton	bales..	1,200

* * * * * * *

The act of March 3, 1881, appropriated $10,000 for continuing this work. A project for the expenditure of this sum was submitted to the Chief of Engineers April 8, 1881, which has been duly approved.

It is proposed to continue the same general plan of improvement and conduct operations as have been done the past year, first, in the river below Conwayborough, and afterwards, should funds permit, above that point.

The Waccamaw River is in the collection district of Georgetown, S. C.

The appropriations for this work have been—

June 14, 1880	$15,000
March 3, 1881	10,000
	25,000

Money statement.

July 1, 1880, amount available	$15,000 00	
Amount appropriated by act approved March 3, 1881	10,000 00	
		$25,000 00
July 1, 1881, amount expended during fiscal year, exclusive of outstanding liabilities July 1, 1880	3,369 29	
July 1, 1881, outstanding liabilities	2,585 51	
		5,954 80
July 1, 1881, amount available		19,045 20
Amount (estimated) required for completion of existing project		4,370 00
Amount that can be profitably expended in fiscal year ending June 30, 1883.		4,370 00

I 20.

IMPROVEMENT OF SANTEE RIVER, SOUTH CAROLINA.

The river and harbor act of March 3, 1879, directed an examination or survey of this river.

The examination was made during the month of November of that year, and a report thereon, accompanied by maps and estimates of cost of proposed improvements, was submitted April 14, 1880, and may be found in the Report of the Chief of Engineers for 1880, part 1, page 916.

The improvement proposed was by the removal of all obstructions, natural and artificial, to secure a free navigation of 7 feet at a low stage of water up to Wright's Bluff, about 154 miles from the ocean, and a depth of 5 feet over the remaining 30 miles of the river, or to the confluence of the Wateree and Congaree rivers.

It was also proposed, as the bar at the mouth of the Santee afforded but little water, and would be difficult and expensive to improve, to deepen and straighten a natural waterway known as "Mosquito Creek," by which vessels from the Santee would have an outlet through "Winyah Bay" to the ocean.

The estimate for this proposed work, including the canal via "Mosquito Creek," 50 feet wide and 7 feet deep, was $104,427.40.

The act of Congress of March 3, 1881, appropriated $22,000 for—

> Improving Santee River, South Carolina, by deepening and straightening its outlet to Winyah Bay, through Mosquito Creek.

A project for the expenditure of this amount has been called for by the Chief of Engineers, but before submitting it a more exact survey of the creek will be made than was possible at the time of the general examination of the river.

The appropriation named herein is the only one that has been made for this work.

The Santee River is in the collection district of Georgetown, S. C.

Money statement.

Amount appropriated by act approved March 3, 1881	$22,000 00
July 1, 1881, amount available	22,000 00
Amount (estimated) required for completion of existing project	82,427 40
Amount that can be profitably expended in fiscal year ending June 30, 1883.	55,000 00

I 21.

IMPROVEMENT OF WATEREE RIVER BELOW CAMDEN, SOUTH CAROLINA.

The act of Congress approved June 14, 1880, directed an examination or survey of this river.

The survey was made in October and November of that year, and a report on the same, accompanied by plan and estimate of cost of improvement, was submitted January 15 last, and will be found printed in House Ex. Doc. No. 61, Forty-sixth Congress, third session.

The improvements proposed consist in the removal of all obstructions, both natural and artificial, so as to secure a navigable depth of 4 feet from Camden to the confluence of the Wateree and Congaree, a distance of 64 miles.

The estimated cost of the improvement is about $54,000.

The act of Congress approved March 3, 1881, appropriated $8,000 for this work.

A project for the expenditure of this sum was submitted May 28, and has been approved by the Chief of Engineers.

The project contemplates carrying out the work indicated above, commenced at those portions of the river most in need of improvement.

The work, owing to its varied character, will be conducted by the hire of machinery and labor and the purchase of material in open market. The appropriation referred to herein is the only one that has been made for this work.

To complete the work proposed will require a further appropriation of $45,991.60, part of which will be devoted to dredging through "Cut-offs."

The Wateree River is in the collection district of Georgetown, S. C.

Money statement.

Amount appropriated by act approved March 3, 1881	$8,000 00
July 1, 1881, amount available	8,000 00
Amount (estimated) required for completion of existing project	45,991 60
Amount that can be profitably expended in fiscal year ending June 30, 1883.	45,991 60

SURVEY OF WATEREE RIVER, FROM CAMDEN, SOUTH CAROLINA, TO ITS MOUTH.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., January 15, 1881.

GENERAL: Your letter of June 17 last placed me in charge of an examination or survey of the "Wateree River from Camden, S. C., to its mouth," said examination or survey having been provided for in the river and harbor act of Congress approved June 14, 1880.

I assigned the field work to a party in charge of Mr. J. P. Darling, assistant engineer, * * * and tracings from the resulting maps, two in number, together with his own report upon the survey, are transmitted herewith. * * *

The Wateree River is merely a continuation of the Catawba River, which rises in the western part of North Carolina, receives its name at the confluence of the Catawba and Wateree Creek, and retains it until it unites with the Congaree River, when it is known as the Santee, which finally empties into the Atlantic at a point about 10 miles south of Winyah Bay, South Carolina.

The upper portion of the Wateree is a rapid mountainous stream, with a fall of over 4 feet to the mile. Below Camden, however, the fall is less, and the river could be made navigable for light-draught steamers without a very great outlay. One such steamer now plies upon the river, engaged solely in local traffic. The main obstruction to navigation are fallen and overhanging trees, snags, stumps, &c., and a few very abrupt bends, around which it is difficult to pass.

The country through which the Wateree flows is very fertile, and a communication to the sea via Santee River would do much to develop its resources.

Any plan for the improvement of navigation of this river should contemplate the removal of all obstructing logs and snags, and the cutting off of five projecting points.

In the estimates submitted herewith, a channel 80 feet in width and 4 feet in depth at lowest stage is proposed at the cuts off.

Mr. Darling estimates that an expenditure of about $54,000 would be required to accomplish the above.

It appears to me that this amount might be expended upon the river to good advantage. If appropriated, the whole amount could be profitably expended during a single fiscal year.

An examination of this river was made under my direction during the fall of 1879, and attention is respectfully called to Senate Executive Document No. 161, Forty-sixth Congress, second session, in which my report upon same will be found.

The Wateree River is in the collection district of Georgetown, S. C.

I am, general, very respectfully, your obedient servant,

CHAS. B. PHILLIPS,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. JOHN P. DARLING, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., January 13, 1880.

CAPTAIN: I have the honor to submit the following report of a survey of the Wateree River from Camden, S. C., to its mouth, made under your direction during October and November, 1880. The accompanying tracings, two in number, show the meanderings of the stream and depth of water at an unusually low stage, according to the testimony of the people along the route.

The general course of the river is southerly, with some very large bends and many abrupt crooks. The upper portion flows through Kershaw County, and farther down it forms the boundary between Sumter and Richland.

The present head of navigation is at Camden, a flourishing and prosperous town, with upwards of 3,000 inhabitants. It is the center of trade for the surrounding counties, which are classed among the most fertile in the State.

There are some very large cotton, rice, and corn plantations along the course of the river, but the exact amount of their productions cannot be ascertained because of their different channels of transportation.

The distance from Camden to the mouth is 64.34 miles, where, by confluence with the Congaree River, it forms the Santee, the principal river of the State, forming thereby a link in a chain of rivers from Western North Carolina to the Atlantic Ocean. There can be no through shipping until the Santee is also improved, making Charleston the nearest and most convenient market.

The width of the river averages about 225 feet, and at present there are but few places with a depth of less than 4 feet. For the first 20 miles cultivated land extends mostly to the river, but the banks are low, and levees have been constructed to protect the fields from overflow, there being a periodical rise in the river of about 20 feet. Further down, the banks are generally low and swampy, the swamps extending from 3 to 4 miles on either side, and are covered with splendid growths of timber, consisting of gum, cypress, pine, and oak, which remain in their native abundance, and would become a valuable adjunct to the products of the country if the means of transportation were sufficient. Owing to the extensive swamps, but few landings exist.

Snags, logs, and drifts abound the whole length. Some of the drifts, consisting of snags, logs, and fallen trees piled upon each other, extend almost entirely across the river, making it not only difficult but dangerous even for boats of the lightest draught to navigate the stream. Sand-bars have been formed at most of the bends, but do not generally interfere.

At places shoals have been formed by sunken logs and snags, which the action of the water would remedy if they were removed. There are a great many leaning trees that would eventually fall into the river, which it will be necessary to remove. Some of the bends are so abrupt that steamers of any considerable size would find great difficulty in navigating, making it necessary to cut off some of the points. These are shown on the accompanying tracings. "Breakovers" at many of the bends are caused by high-water.

The Wilmington, Columbia and Augusta Railroad crosses the river 51.66 miles below

Camden. The bridge is constructed of wood, without a draw; its length is 344 feet, height of track above low-water 40.6 feet, height of bottom of bridge 16.9. The Camden branch of the South Carolina Railroad, having its terminus at Camden, traverses the country east of the river and nearly parallel with it, crossing 33 miles below by rail, and 56.7 by water, connecting at Kingsville, 5 miles from the river, with the main branch between Charleston and Columbia. This bridge is also built of wood, without a draw; length 418 feet, bottom 15.3 feet above low-water, height of track 18.9 feet. The high rates of freight on these roads, owing to the railroad monopoly, is the great drawback to this section of the country.

There is one small steamer plying between Camden and the Wilmington, Columbia and Augusta Railroad Bridge, but she can carry comparatively little of the produce that would be shipped if the river was opened to larger boats, and offered fewer obstacles to navigation. Between these points the following amount of produce was shipped during the year 1880:

12,000 barrels rosin and spirits.
4,000 bales cotton.
30,000 bushels rice.

These statistics were kindly furnished me by Mr. W. L. Arthur, of Camden.

The following is my estimate for cutting off points and removing obstructions:

Place.	Quantity.	Description.	Cost.	Amount.
Cut No. 1 ....cubic yards..	11,573	Dredging	$0 25	$2,893 25
Cut No. 2 ....do......	15,111	.....do	25	3,777 75
Cut No. 3 ....do......	24,026	.....do	25	6,006 50
Cut No. 4 ....do......	5,476	.....do	25	1,369 00
Cut No. 5 ....do......	10,666	.....do	25	2,666 50
	2,808	Snags..................	5 00	14,040 00
	2,104	Fallen trees and logs..	8 00	6,312 00
	3,264	Leaning trees.........	2 00	6,528 00
Removing 4 drifts of logs and snags			300 00	1,200 00
Removing obstruction, wreck from old bridge			200 00	200 00
Total..				44,993 00
Engineering and contingencies, 20 per cent				8,998 60
Total..				53,991 60

The estimate for cuts is for 4 feet of water, and 80 feet width on bottom.

I am, captain, very respectfully, your obedient servant,

JNO. P. DARLING.

Capt. CHAS. B. PHILLIPS,
Corps of Engineers, U. S. A.

I 22.

SURVEY OF GEORGETOWN HARBOR, SOUTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., January 18, 1881.

GENERAL: The river and harbor act approved June 14, 1880, provided for an examination or survey of Georgetown Harbor, South Carolina. This survey having been by your letter of June 17 last assigned to my charge, I intrusted the work to Assistant Charles W. Forster, who after organizing a party, commenced the field-work on the 19th of last August and completed the same on the 26th of September, * * * and his report upon the survey and a tracing from his map exhibiting the condition of the harbor and its proposed improvement are respectfully transmitted herewith.

Georgetown is situated at the head of Winyah Bay, South Carolina, at the confluence of the Pee Dee, Waccamaw, Black, and Sampit rivers. It is a port of considerable and growing importance, and will become a large city when its natural advantages are made use of. It is the natural outlet of a vast section of fertile country, the principal products of which are cotton and rice. Almost inexhaustible quantities of timber and naval stores are also to be found on the streams tributary to Winyah Bay.

After passing the bar at the entrance to Winyah Bay, the only obstruction met with by vessels trading with Georgetown is a bar at the entrance to the harbor, or, really, at the mouth of Sampit River. This bar is 2,850 feet in length, and affords a depth of only about 9 feet at ordinary low-water. As vessels drawing 12 feet of water frequently leave Georgetown, much detention occurs while waiting for high-water. It is proposed to obviate this difficulty by dredging a channel across this bar 200 feet in width at bottom and 12 feet in depth at ordinary low-water.

The course of the proposed dredged channel is shown on the accompanying map. The character of the bottom is such that it may be reasonably expected that a dredged channel will remain for a long period of years.

As per Mr. Forster's estimate, which appears to be a reasonable one, the cost of this work will be a trifle over $14,000. I think that this amount might well be expended in giving a great impetus which no doubt would follow to the trade of such an important port.

Georgetown, S. C., is a port of entry.

I am, general, very respectfully, your obedient servant,

CHAS. B. PHILLIPS,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. CHARLES W. FORSTER, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., January 17, 1881.

CAPTAIN: I have the honor of submitting to you my report of the survey of Georgetown Harbor, South Carolina, made by me under your verbal instructions.

* * * * * * *

Georgetown is the only port of entry between Wilmington, N. C., and Charleston, S. C. Lying at the head of Winyah Bay, at the confluence of the Waccamaw, Pee Dee, Black, and Sampit rivers, it is the natural outlet of an immense extent of back country, including the entire counties of Georgetown and Horry and a large portion of Williamsburg, Marion, Darlington, Chesterfield, and Marlborough counties.

At present, as stated in my report on the Waccamaw and Pee Dee rivers, made last year (see Chief of Engineer's Report for 1880, Appendixes I 16 and I 15), a large proportion of the commerce of these rivers goes through to Charleston for distribution on account of the want of shipping facilities at Georgetown.

The present commerce of Georgetown is carried on principally through a line of eight "terns," or three-masted schooners, Messrs. Congdon, Hazard & Co. being part owners, one or two of them having been built in these waters. These vessels average 450 tons and 12 feet draught apiece.

The following will give an idea of the amount of commerce of this port:

There are about 175 sail of vessels passing over the bar a year. The tonnage of these vessels ranges from 50 to 500 tons each, and the draught of water from 6 feet to 12 feet 3 inches. There are shipped over the bar in this time by sailing vessels and steamboats, as follows: 20,000,000 feet of lumber, 250,000 barrels naval stores, 15,000 casks of rice, 15,000 to 18,000 bales of cotton.

With regard to the lumber trade, Mr. David Risley, one of the lumber merchants, states that he alone loads 52 vessels per annum, of from 150 to 400 tons capacity, and that he is now engaged on improvements which will, when completed, double his shipments.

Parties from Wilmington are also now prospecting with a view of erecting saw-mills in, or in the vicinity of, Georgetown.

The shipment of rice direct to northern ports is also increasing since the establishment of a large rice-pounding mill in the town, during the past eighteen months.

The harbor consists of about one mile of the Sampit River. The survey was commenced at the upper end and extended to the mouth, and as far into the bay as buoy No. 9 and the United States Coast Survey station. In the upper part there is from 30 to 40 feet water, shoaling to 14 and 15 feet in the more frequented parts around the wharves, and at the mouth to 8 and 10 feet. It will be seen by the accompanying maps that the 12-foot contour includes the whole of the interior of the harbor with the exception of a shoal commencing opposite the lower wharves and extending 1,500 feet down stream, but which at present does not form any important obstacle. The difficulty lies in the shoal across the mouth of the harbor, which extends clear across for a distance of 2,850 feet with an average depth of 9 feet, and is composed of sand and mixture of sand and mud.

To obviate this difficulty would require the dredging of a channel 200 feet wide, the center line commencing 400 feet northeast of buoy No. 9 and running N. 30½° W. 2,100 feet, and from there N. 5° W. 750 feet to the 12-foot contour. To give an increase of 3 feet in this channel will require the removal of 64,327 cubic yards.

To dredge this, at 20 cents per cubic yard, would cost	$12, 865 40
Add 10 per cent. for contingencies	1, 286 54
Total	14, 151 94

The people of Georgetown have begun to wake up to the importance of their harbor since (on account of its being the nearest on the coast in the direct line from Saint Louis) railroad men have turned their attention to it as a probable outlet for Western produce, and great interest is now shown in the improvement of the harbor and bar, and I respectfully recommend the above improvement to be made.

I am, very respectfully, your obedient servant,

CHAS. W. FORSTER.

Capt. CHAS. B. PHILLIPS,
Corps of Engineers, U. S. A.

I 23.

EXAMINATION OF LYNCH'S RIVER, SOUTH CAROLINA.

UNITED STATES ENGINEER OFFICE,
Norfolk, *Va.*, *January* 17, 1881.

GENERAL: The river and harbor act of June 14, 1880, provided for an examination or survey of Lynch's River, South Carolina. The execution of this work having been assigned me by your letter of the 17th of June last, I placed the field work in the hands of Mr. J. P. Darling, assistant engineer; * * * and tracings, seven in number, from the original maps, together with his report, are respectfully transmitted herewith.

Lynch's River is a tributary of the Great Pee Dee River, emptying into the latter from the west, at a point about 30 miles above the confluence of the two Pee Dees.

The stream drains an exceedingly fertile section of country. The products are mainly shipped by rail, the shipments by river being confined almost exclusively to timber in the form of rafts.

Mr. Darling in his report gives a detailed description of the river, and points out the difficulties to be overcome in order to make the river a navigable stream. The river is exceedingly tortuous, shallow, and narrow, and to attempt to improve it for even light-draught steamboat navigation would involve an immense expenditure of money. At one point near the mouth the river is but 20 feet in width, and at other points only 1 foot of water can be found, with a bottom of compact sand generally, and at one point of solid rock.

At present a light-draught skiff cannot navigate the river without frequently stopping to haul over obstructions.

The removal of the worst obstructions, such as sunken logs, snags, fallen trees, &c., would no doubt increase to a great extent the lumber trade upon the river, and steamers might be induced to navigate the stream during the "flush water" months of the year; but beyond the removal of said obstructions I cannot properly recommend any other plan of improvement.

To remove the snags, logs, fallen and overhanging trees upon the river, the number of each in Mr. Darling's estimate being by actual count, would require the expenditure of about $45,000. This amount, if appropriated, could be profitably expended during a single fiscal year. * * *

Lynch's River is in the collection district of Georgetown, S. C.

I am, general, very respectfully, your obedient servant,

CHAS. B. PHILLIPS,
Captain of Engineers.

The CHIEF OF ENGINEERS, U. S. A.

REPORT OF MR. JOHN P. DARLING, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., January 15, 1881.

CAPTAIN: I have the honor to present herewith my report with accompanying tracings (seven sheets) on the recent examination of Lynch's River, South Carolina, from the Wilmington, Columbia and Augusta Railroad Bridge to its mouth.

In accordance with your instructions, after the completion of the surveys in North Carolina, under my charge, I proceeded at once to Cartersville, a station on the Wilmington, Columbia and Augusta Railroad, 1 mile from the point where we were to commence work.

* * * * * * *

From Cartersville on either side of the stream, with the exception of a few miles of high land near Effingham Station on the Northeastern Railroad, dense growths of swamp woods abound, with here and there an occasional ton-timber landing. The rafting of this material seems to be the only profitable use to which the river can be put without a great outlay of money.

Launching our boats at the Wilmington, Columbia and Augusta Railroad Bridge, our progress to Old Effingham, a distance of 35.6 miles, was slow and laborious.

Traveling at current speed we were enabled to make a very careful examination of the many crooks and bends, giving bearings, distances, and widths, as shown on the tracings, and an accurate enumeration of the logs, snags, fallen and leaning trees, and other impediments to navigation. Owing to the extreme low-water, which lasted throughout the work, the soundings which were taken at intervals of about 50 feet required no reduction. Through this section the river has a width of from 60 to 100 feet; it runs over a hard, sandy bottom, and in many places shoals to within a few inches of the surface, owing partly to the great accumulation of logs buried under the sand. The banks are low and swampy, the thick foliage of the overhanging trees in many instances entirely obscuring the sun. In many places logs and fallen trees completely blocking our passage, it became necessary to cut a way through when the boats could not conveniently be lifted over. This difficulty necessitated having the baggage carried by land from camp to camp.

From Old Effingham to the Northeastern Railroad Bridge, a distance of 4 miles, and to the rapids or shoals, 3 miles more, the river has an average width of 125 feet, with long, straight reaches, and high, cultivated banks. From about 600 feet above Old Effingham to the railroad bridge, the river in several places passes over a hard sandstone formation, which occasionally rises to within 15 inches of the surface. This is probably the same stratum of rock which traverses this section of the country, making its appearance on the Pee Dee at Stone Landing, and in the form of rapids on the Upper Santee.

The rapids 3 miles below the railroad bridge are 100 feet long, with an average depth of 1 foot, and a fall of 0.6 foot. These rapids are filled with logs lodged in the stream. From here to Johnson's Ferry, a distance of 39.7 miles, we have a repetition of the sharp crooks and bends, rapid current, and many logs and snags. In this distance the river is narrow, and runs through low, thick swamps, with an occasional bluff. The depth varies from 1 to 7 feet, with an average width of 60 feet, although in several instances the stream narrows considerably. At the Wild Cat Rapids, one-half mile above Canebreak Landing, the river for a distance of 200 feet flows through a cut, with an average width of 20 feet, and a fall of 2 feet: the current is very swift.

From Johnson's Ferry to the mouth, a distance of 7½ miles, the river if possible becomes more crooked, meandering through a dense swamp, with shorter reaches and more acute bends; the current runs with a velocity of about 3 miles per hour, the width not averaging over 50 feet; 200 feet below Persimmon Landing is Lawrence's Cut, which is a shorter passage to the Pee Dee, via Clark's Creek; which creek makes from Lynch's, 1 mile above its mouth, to the Pee Dee, 11 miles below, forming Snow Island, of Revolutionary fame; we were unable to examine this route, on account of low-water. Two hundred yards below Clark's Creek, the river has washed a new channel, forming a small island, 500 feet long, called Needle's Eye; in this channel there are rapids 250 feet long, with a fall of about 2 feet. The lower end is completely blocked with logs and fallen trees.

Between the rapids and the mouth, a distance of nearly a mile, the river is again obstructed with drift-wood in several places. At its mouth there is a large sand-bar, which nearly fills the entrance to the river.

The cost of improving this river for steamers would be so great that I do not think the commerce would justify Congress in doing so but for ton timber, of which there are about 10,000 sticks annually rafted from Cartersville. I have made the following estimate for removing snags, logs, &c.:

No.	Description.	Cost.	Amount.
1, 638	Snags	$7 00	$11, 466 00
4, 182	Logs	4 00	16, 728 00
404	Fallen trees	4 00	1, 616 00
3, 856	Leaning trees	3 00	11, 568 00
			41, 378 00
Add 10 per cent. for superintendence			4, 137 80
	Total		45, 515 80

The number of snags, logs, &c., are by actual count, and therefore I have allowed a liberal price to cover those that were not seen.

* * * * * * *

I am, very respectfully, your obedient servant,

JNO. P. DARLING,
Assistant Engineer.

Capt. C. B. PHILLIPS,
Corps of Engineers, U. S. A.

I 24.

EXAMINATION OF BLACK RIVER FROM KINGSTREE, SOUTH CAROLINA, TO ITS MOUTH.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., January 26, 1881.

GENERAL: Your letter of instructions, dated June 17 last, placed me in charge of an examination or survey of the "Black River, from Kingstree, S. C., to its mouth," the same having been provided for in the river and harbor act approved June 14, 1880.

I placed the work in the hands of my assistant, Mr. Charles W. Forster, who had been before engaged upon the survey of Georgetown Harbor, South Carolina, and tracings, three in number, from the resulting map, and his report upon the examination, are respectfully transmitted herewith.

The Black River empties into the Great Pee Dee River at a point about 4 miles above the town of Georgetown, S. C. The total distance by river from the town of Kingstree to its mouth is 120 miles. From the mouth for a distance of something over 45 miles, or to what is known as Pine Tree Landing, a deep and navigable river is to be found, free from obstructions, and with a depth of at least 10 feet at all stages. Steamers run regularly upon this portion of the river, and no improvement seems necessary.

Above Pine Tree Landing for a distance of 11 miles, or to Potato Ferry, the river is very crooked and shoal. This portion of the river is occasionally navigated by light-draught steamers, but not more than 3 feet of water can be depended upon. The bottom is mostly rock, and an immense expense would be involved in attempting to excavate a channel through it—an expense which would not be warranted by the present importance of navigation in the river.

Above Potato Ferry, and from thence to the town of Kingstree, there is literally no navigation, the river being almost a continuous shoal, with less than 1 foot of water at low stages. Nor does it appear that, if this portion of the river were opened to navigation, much use would be made of the increased facilities for transportation. I have not deemed it necessary to make estimates for the improvement of any portion of this river, and none are submitted.

The Black River is in the collection district of Georgetown, S. C.

I am, general, very respectfully, your obedient servant,

CHAS. B. PHILLIPS,
Captain of Engineers.

The CHIEF OF ENGINEERS, *U. S. A.*

REPORT OF MR. CHARLES W. FORSTER, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Norfolk, Va., January 25, 1881.

CAPTAIN: I have the honor to submit to you a report of the examination of the Black River, South Carolina, made by me under verbal instructions received from you August 6, 1880.

On completing the survey of Georgetown Harbor, made under instructions received at the same time, I proceeded to Kingstree, the point from which the examination was ordered to be commenced.

At the very outset I lost the valuable assistance of Mr. C. M. Yeates, who was taken sick from the effect of exposure during the survey of Georgetown Harbor, and on his recovery was given charge of the survey of Beaufort Harbor, North Carolina. I was myself taken sick just after my arrival at Kingstree, and on the 13th of October was obliged to disband my party and return to Georgetown until I could recover, and it was not until the 22d of November that I was able to get out again and return to my duties. I then returned to Kingstree, but was detained there by continuous rains until the 30th, when I at last got a start on the river, and continued the examination without further interruption, and completed it December 10. On account, however, of the time already lost, the examination was necessarily very hasty and superficial, and the river being at this time about 4 feet above its ordinary height, I was unable without great loss of time to make a very complete examination of the nature of the bottom.

The length of this river from Kingstree to Georgetown is about 120 miles.

From Kingstree to Potato Ferry, a distance of 68 miles, the river is much obstructed by long sand and rock shoals, which during the greater part of the summer are either dry, with little channels finding their way across them, or have only from 6 to 18 inches of water on them.

From Potato Ferry, for about 10 miles, the river is very crooked and shoal, having in most places at low stages not more than 3 feet of water.

From Pine Tree Landing, 79 miles below Kingstree, the nature of the river changes entirely, and becomes deep and comparatively straight, the navigation being good from this point to Georgetown.

The highest point to which traffic is carried on this river at present is Potato Ferry, and, as above stated, the river is good to within 10 miles of this point; and as in this intervening portion the obstructions consist chiefly of rock shoals, the expenditure necessary for improvement would be greater than the probable benefit would warrant.

Above Potato Ferry there is no traffic, and no apparent prospect of any arising from an opening of the river. The people along the river seem perfectly indifferent to the improvement, especially as they are making arrangements for building a railroad from Georgetown to cross the Northeastern Railroad at or near Kingstree, which, together with the Northeastern Railroad, will supply all the needs of traffic of the surrounding country. I make no estimate of cost, as I cannot, under these circumstances, recommend any expediture on this river.

Very respectfully, your obedient servant,

CHAS. W. FORSTER.

Capt. CHAS. B. PHILLIPS,
Corps of Engineers, U. S. A.

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